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THE RENOLD SILENT CHAIN IN CONNECTION WITH MACHINE AND STRUCTURAL TOOLS.

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Recent articles in Machinery about motor-driven shops, current advertisements of motor-driven tools and the ever-present motor salesman, all remind the machine-shop manager that this is an age of electricity. If his shop is already equipped with motors, he can probably cite endless figures to

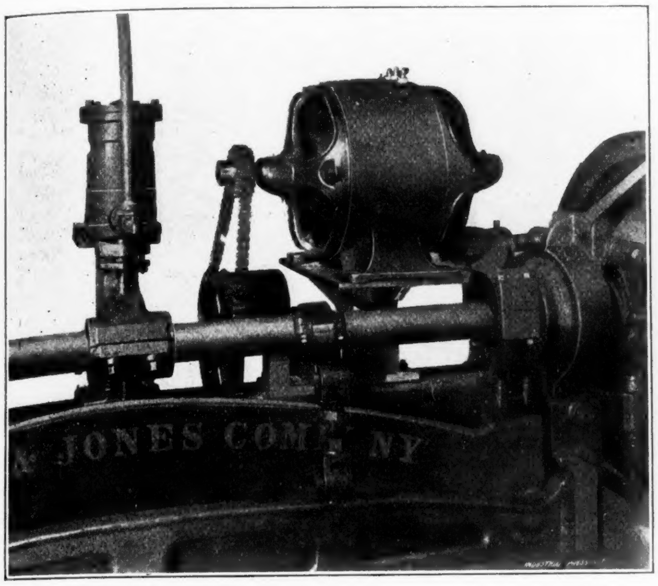


Fig. 1. Hilles & Jones Gate Shear. Driven by General Electric Motor and Renold Chain.

show the correctness of his judgment in the particular system selected, and if he is only trying to decide on a system he is probably seemingly mixed up inextricably in figures on first cost, interest and depreciation, power factor, speed-regulation, etc.

After the system to be adopted is decided on, there next arises the question of how far to carry the individual motor

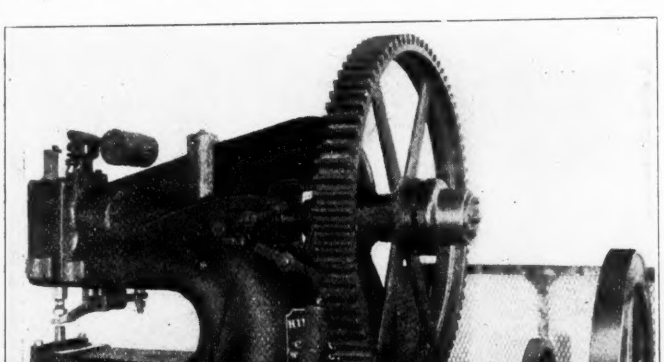


Fig. 2. Hilles & Jones No. 2 Punch. Driven by General Electric 7 1-2 H. P. Motor and Renold Chain. 975 r. p. m., Chain Speed 1160 feet per minute.

and when to start grouping small tools on line shaft. The character of the work to be done will have something to do with this decision. If the work is miscellaneous then the individual motor is desirable, because one of the greatest advantages to be derived from electrical drives is ease in speed control. If, however, the processes are essentially the same day after day, then countershafting and the group system may be desirable, having in mind always, however, the necessity for clear space for crane service.

When a decision has been reached as to the most desirable distribution of the motors, the next problem is how to connect the motors to the tools and the line shafting. It is probable that when this point is reached many modifications of

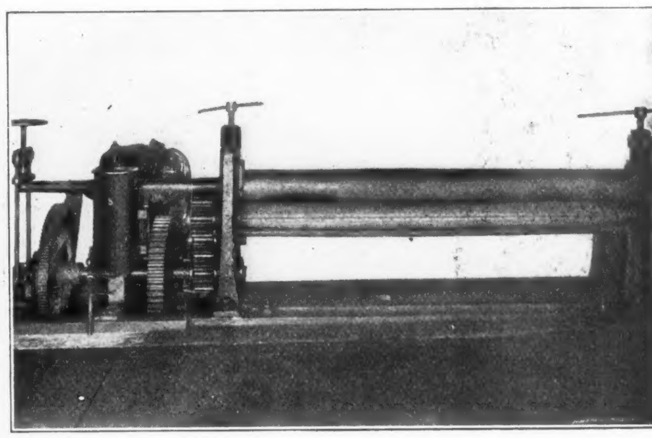


Fig. 3. Bending Rolls. Driven by Series Motor and Reversing Controller. 7 1-2 H.P. Motor, 750 r. p. m. Renold Chain Drive. Chain Speed 950 feet per min.

the original scheme will be necessary. There need be no surprise if tools designed before the direct electrical drive was thought of should present seemingly insurmountable difficulties in motor attachment. It is as a simplifier of these problems that the Renold silent driving chain is important. Its use in connection with machine tools may readily be

Fig. 4. Snyder Drill Press. Two-H.P. Motor, 1000 r. p. m. Renold Chain Drive. Chain Speed 1100 feet per minute.

divided into two classes. In the first it is used as an integral part of the machine, for driving the spindles and feeds and for the general transmission of motion within the ma-

chine itself. In the second it is used for driving the machine and with this last we are now concerned.

As has been inferred above, the application of motors to machine tools is sufficiently difficult where the tools are being designed for electrical drive; where motors are to be applied to old tools, the problem is greatly complicated.

The advantages of Renold chains for such work arises from their convenience and adaptability. For spur gearing the motor

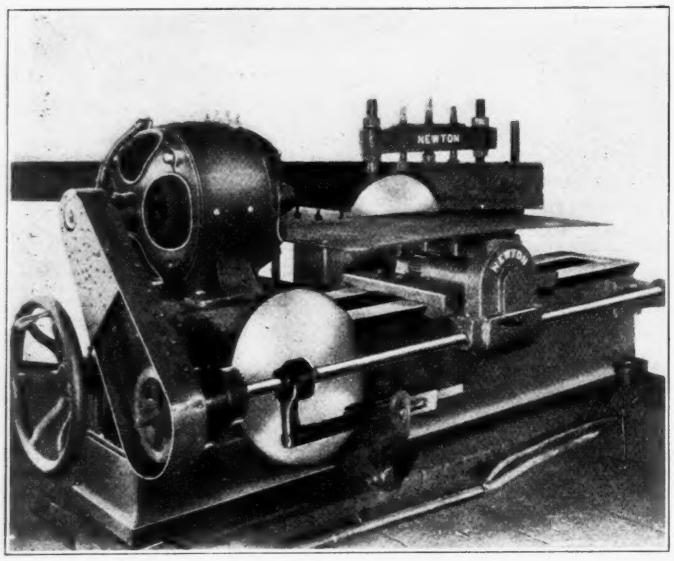


Fig. 5. Newton Cold Saw with Renold Chain Drive. Five H. P. Motor, 975 r. p. m. Chain Speed 1160 feet per minute.

must be provided with an absolutely rigid support, rigidly attached to the tool. The center distance is dictated more or less by the gears and not by convenience. The noise made is generally objectionable. Rawhide pinions are often used and vary greatly as to durability. A worn raw-hide pinion, however, is noisy and also causes a chattering that tends to make the brushes jump, with a consequent burning out of the commutator.

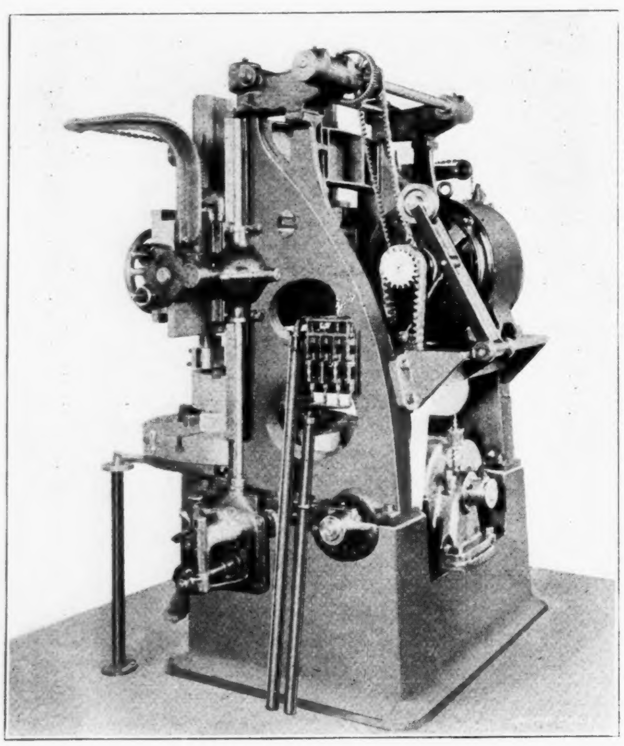


Fig. 6. Bullard 37-inch Boring Mill, Bullock Variable Speed Motor, Renold Chain Drive.

The other alternative to the chain drive is, of course, the belt. If a belt be run on short centers an idler must be used, with a corresponding loss of efficiency and convenience. A belt also lacks the advantage of positive connection possessed by spur and chain gearing. Many unexplained failures to get expected output are due to slipping belts. The Renold chain, in contrast to belts, or other method of connection, is thus silent, efficient, positive and convenient.

When it was decided to equip the shops of the Link-Belt Engineering Company electrically it was concurrently de-

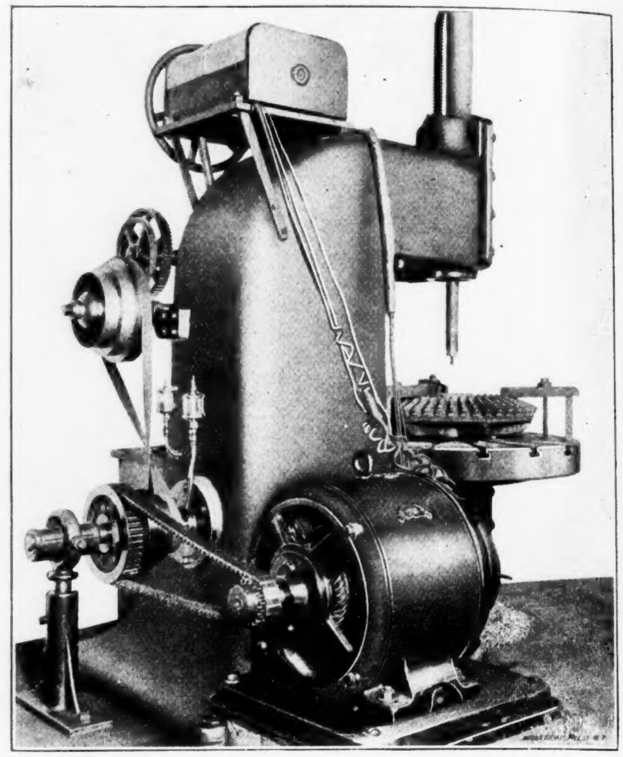


Fig. 7. Betts Car-wheel Mill, Motor-driven, Renold Chain Drive.

cided to do it in the best possible way in the light of the information then obtainable. Some things were done, of course, that would be done differently if the job were to be done again; but in the main the change has been eminently satisfactory from every standpoint. Every tool was studied as a separate problem, and it is now possible to show, by

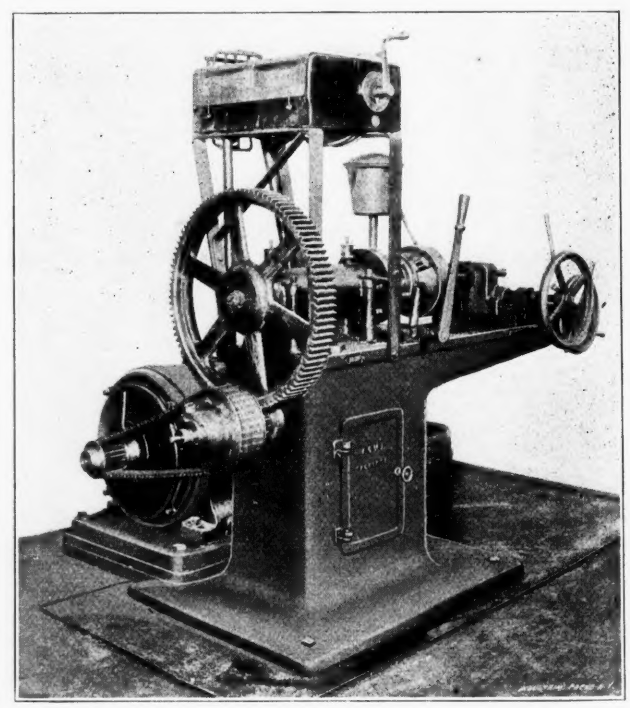


Fig. 8. Acme Bolt Cutter, Motor Driven, Renold Chain Drive.

comparative records, the very substantial gains made by the change.

At about the same time when the application of motors to the various tools was being studied out, this company began the manufacture of the Renold silent chain gear in this country. While a great deal of it is used in the shops, still nowhere is a foot used where it is not the best thing for

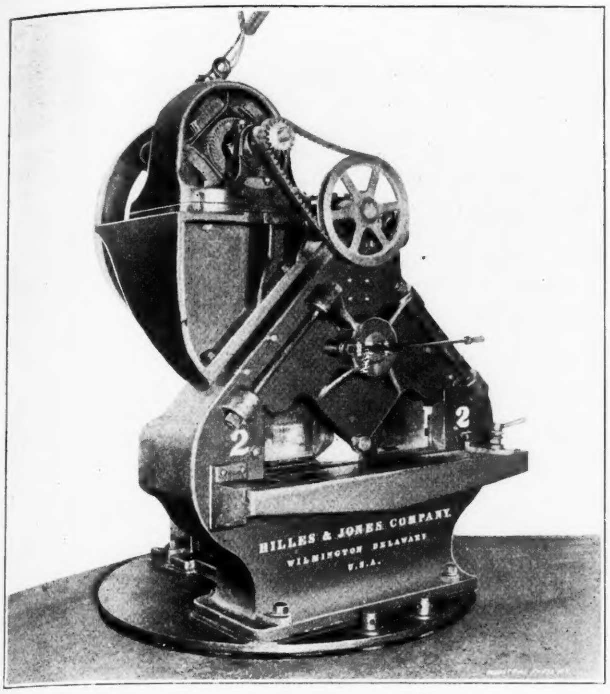


Fig. 9. Hilles & Jones Angle-iron Shear 10 H. P. Motor, 750 r. p. m. Renold Chain Speed 1190 feet per minute.

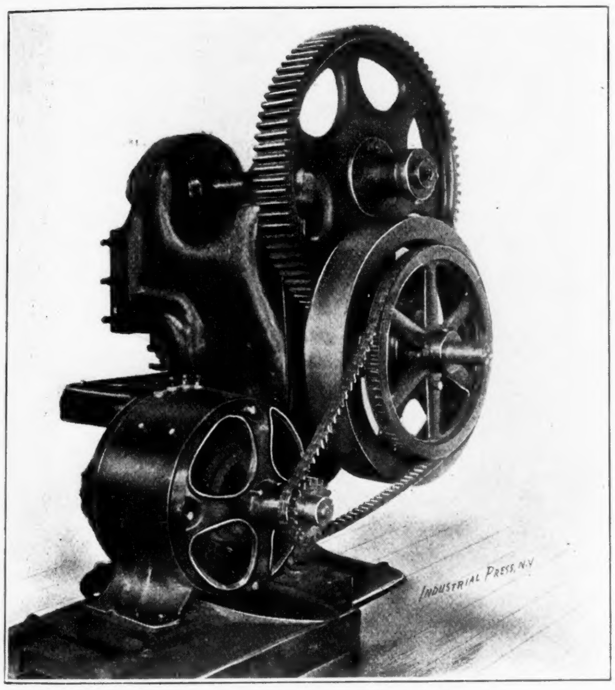


Fig. 10. Ferracute Punch, Motor Driven, Renold Chain.

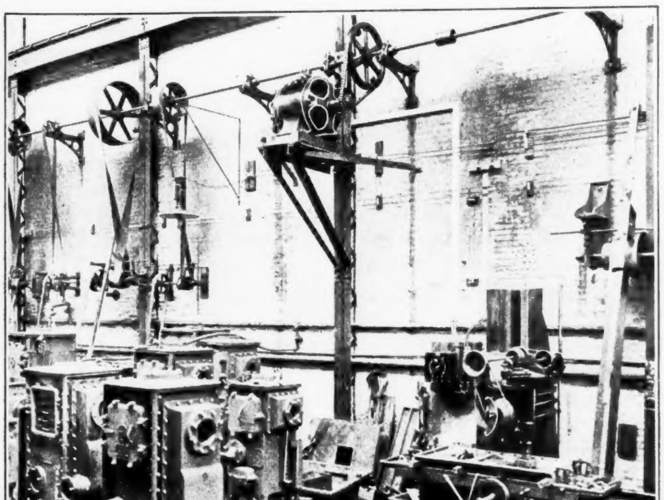


Fig. 11. Line Shaft Driven by 15 H. P. Motor and Renold Silent Chain.

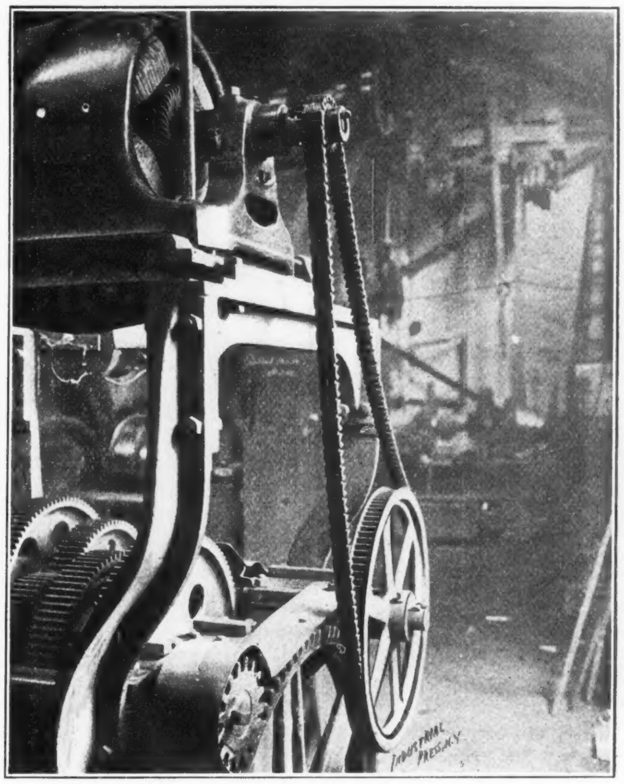


Fig. 12. Old Roll Lathe Driven by Westinghouse Motor, Renold Chain.

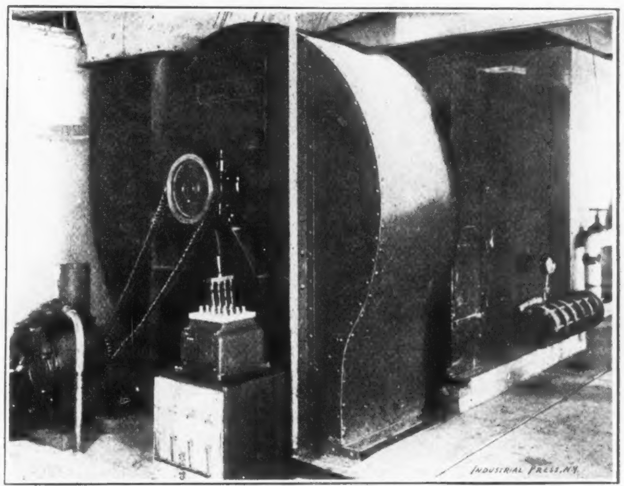


Fig. 14. Sturtevant Heating Fan, Motor Driven, using Renold Chain.

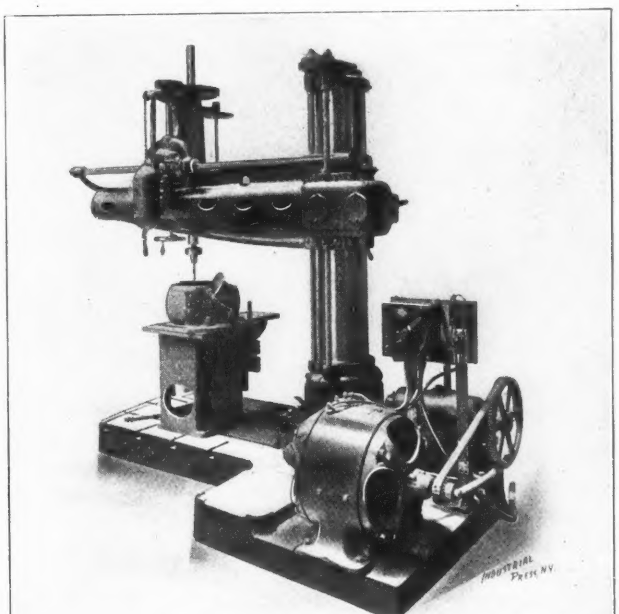


Fig. 16. Bickford Radial Drill, with Motor on Extension Base. Constant Speed Motor, Renold Chain Drive.

the place. There are belt drives and spur-geared drives, and while their number is small compared to the number of chain drives, it represents very fairly about the proportion that such drives should bear to chain drives in the ordinary shop.

Concisely stated, the advantages of the Renold chain are, that it may be run on shorter center distances than a belt and on longer centers than spur gearing. The center distances are dictated only by convenience and may be fixed, or the motor

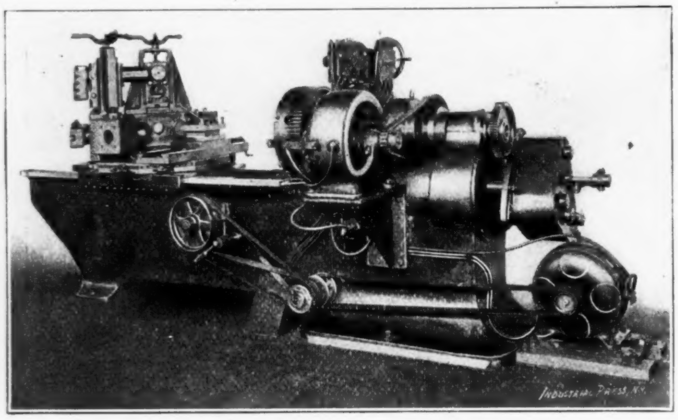


Fig. 13. Renold Chain Drive from Crocker-Wheeler Motor to American Turret Lathe.

may be mounted on rails. The chain is silent; it is efficient; it is compact; the drive is absolutely positive and the calculated output is a certainty.

The majority of the accompanying cuts are from photographs taken in the Link-Belt Engineering Co.'s works at Nicetown, Philadelphia. They are intended to show as large a variety of tools and motor applications as possible. In nearly every case the tools were originally belt-driven. In at least five cases the method shown for attaching the motor has been adopted by the builder of the tool as his standard. In the main, the photographs speak for themselves, but a few comments on some of them will not be out of place:

Figs. 1 to 10 inclusive show drives in these works. Most of those shown are on structural tools, which arises from the fact that many of the motors in the machine shop are below the floor and are therefore difficult to photograph satisfactorily.

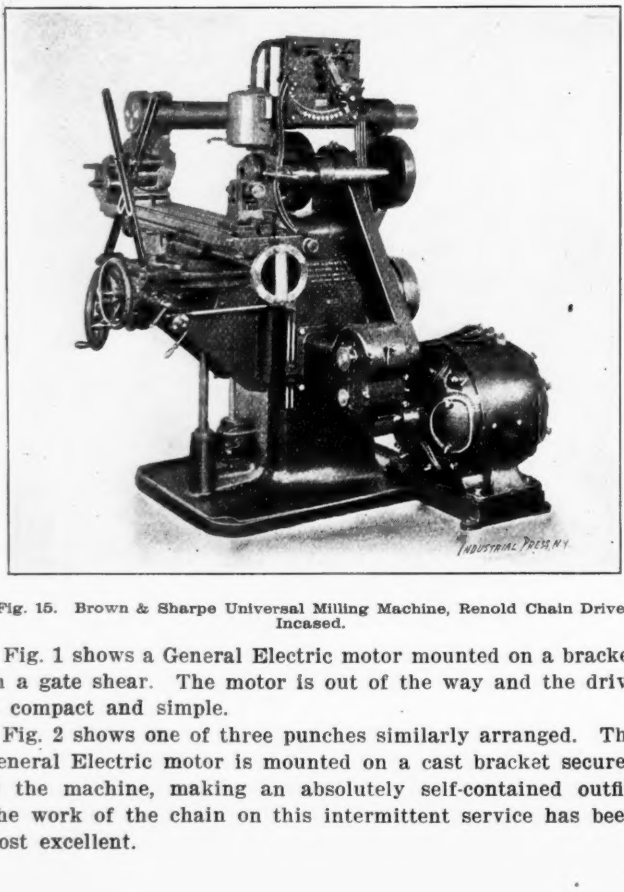


Fig. 15. Brown & Sharpe Universal Milling Machine, Renold Chain Drive Incased.

Fig. 1 shows a General Electric motor mounted on a bracket on a gate shear. The motor is out of the way and the drive is compact and simple.

Fig. 2 shows one of three punches similarly arranged. The General Electric motor is mounted on a cast bracket secured to the machine, making an absolutely self-contained outfit. The work of the chain on this intermittent service has been most excellent.

Fig. 3 shows a set of bending rolls. These were formerly driven by two belts and double clutches. The present arrangement, while thoroughly serviceable and much more easily handled than the old rig, is, at the same time, sightly, compact and efficient. This tool illustrates, perhaps, as well as any other, the possibilities of the Renold chain in converting old tools to the motor drive.

Fig. 4 shows a drill press, a type of several, all of which show increased output, because the chain does not slip.

Figs. 5 and 6 show tools as now supplied by the builders. The arrangement on the Newton cold saw (Fig. 5) was designed by the Link-Belt Co. and is now used by the Newton Machine Tool Works on motor-driven saws supplied by them. The method of attaching the motor to the Bullard 37-inch mill, shown in Fig. 6, was developed by the Bullard Machine Tool Co. It brings out in no less a degree than Fig. 5 the fact that a minimum change in the tool itself is necessary to attach the motor, where the Renold chain is used. It will be noted that the tool is standard in every way except for the addition of the motor base, which is held by the top bolts shown. This feature of building motor-driven and belt-driven tools from the same patterns is one much appreciated by the tool builders.

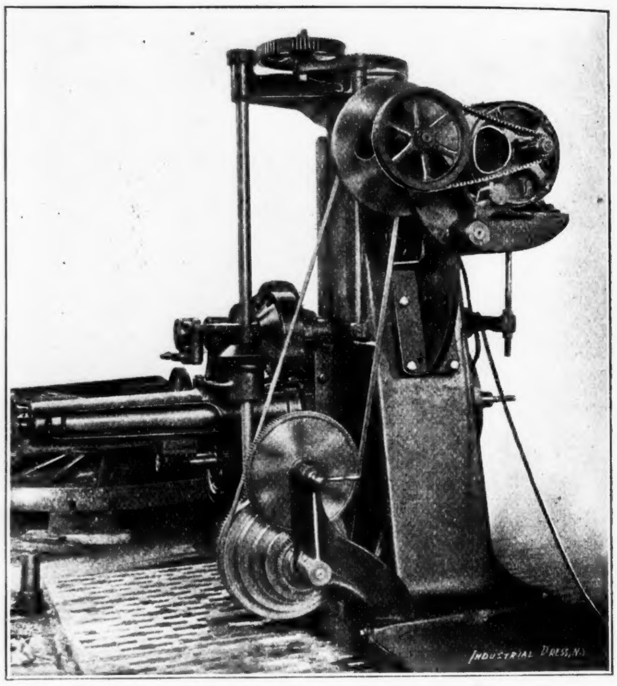


Fig. 17. Floor Boring Machine, Electrically Driven, Renold Chain.

Fig. 7 shows a Betts car-wheel mill with Bullock variable speed motor.

Fig. 8 shows an Acme threading machine with variable speed reversing motor. The superiority of this arrangement over the usual one, with two belts and two shifters, is obvious.

Fig. 9 shows an angle-iron shear driven by a Westinghouse motor. This was supplied with a spur-gear connection by the makers, there being one idle gear. Silent chain was substituted as an experiment and a saving of 15 per cent. in current was found. This was not altogether unexpected, because the efficiency of the silent chain gear is about 96 per cent.

Fig. 10 shows a Ferracute punch; motor on wood base.

The rest of the photographs were taken elsewhere, but show typical machine-shop practice.

Fig. 11 is a line-shaft drive.

Fig. 12 shows a motor-driven roll lathe.

Fig 13 shows a Crocker-Wheeler variable-speed motor connected to an "American" turret lathe.

Fig. 14 shows a heating fan drive.

Fig. 15 a standard Brown & Sharpe universal milling machine with encased Renold chain drive applied by the makers.

Fig. 16 shows a Bickford radial drill with a General Electric motor mounted on an extension to the base of the tool.

Fig. 17 shows an old floor boring machine converted to electric drive.

SHOP CONSTRUCTION.—3.

THE CHIMNEY OR STACK—ITS DESIGN AND CONSTRUCTION.

OSCAR E. PERRIGO.

Thus far our methods of construction, and the necessary materials for them have been such as are encountered daily by the architect and the builder. We now come to the erection of the chimney or stack, which has many peculiarities and restrictions on its design and construction, resulting from its narrow foundation, great height, and the necessity of its resisting not only the high wind pressures and great changes in temperature at different seasons but also the great difference of temperature on the inside and on the outside. It seems to us necessary, therefore, to treat this subject of chimney construction in a separate article, wherein we will consider the respective merits of and the objections to chimneys of the more common forms and materials.

Regarding the chimney built of brick, the principal objections would appear to be its first cost, which is considerable, and the fact that owing to its narrow base and great height very firm and solid foundations must be prepared. This, of course, becomes more difficult and expensive where the ground is soft and excavations must be made at great depth, or where piles have to be driven to build the foundation upon. At the present time many sheet-iron or steel chimneys are erected, and it is the prevailing idea that they are the more economical. About the only advantage they seem to possess, however, is that owing to their comparatively light weight they may be erected on superstructures upon which a brick chimney could not. Then too, their first cost is much less than for a brick chimney of equal capacity. Some of their disadvantages are, that they are very liable to rust at the seams and rivets, owing to the impossibility of keeping these points properly protected from water. Therefore they are comparatively short-lived. Again, in the effort to protect the metal they must be frequently painted, or coated with some of the numerous "cure-all" paints, "warranted to protect them perfectly inside and out;" and the use of *any* protective covering is a continual expense for maintenance to which the brick chimney is not subject.

The conclusion, therefore, must be that, if the life of the chimney is of less consideration than its first cost, we would adopt that constructed of sheet-iron or steel; but if we regard permanency and the ultimate outlay, both for construction and maintenance and all the advantages derived, brick is evidently the material to be chosen.

The height of the chimney will depend somewhat upon surrounding hills, high buildings and similar obstructions to the free course of the wind, but should never be less than the diameter of the internal flue multiplied by twenty. The diameter of the internal flue will depend on the aggregate areas of the smoke flues or "up-takes" leading from the boilers, and these necessarily depend upon the grate surface, allowing about 4.5 square feet per horse power. There are many methods of calculating the diameter of chimney flues, some of which are very complex and depend upon many assumed conditions at each step, which ofttimes have hardly more practical value than guesses. Others assume to calculate the volume of gases, the speed of their flow, the area of grate openings, etc., all of which might be changed with each sample of coal, or according to the condition of the weather. Practical engineers will probably favor the following simple method, even with its arbitrary assumptions, and will be quite successful in the practical application of it as it is the result of much actual experience. The horse power being given—say, in this case 470—and allowing 4.5 square feet of grate surface per horse power, we have 104.4. At 5 pounds of coal per horse power, which is quite liberal, we will burn 2,350 pounds of coal per hour. Our chimney is 100 feet high. We divide the pounds of coal burned per hour by the square root of the height multiplied by 12 ($10 \times 12 = 120$) and we have 19.58 as the area of the chimney flue, in square feet. Divide this by .7854 and extract the square root and we have the diameter, slightly less than 5 feet. Having the diameter of flue and height given we may by inverse methods obtain the horse power, grate surface, etc. In making these calculations we should be sure to get capacity enough; for if the chimney is a little too large no harm is done, while if a little too small a serious expense is incurred for a supplementary one.

All chimneys over 75 feet high should be built with a central "core," or flue, preferably of circular form, surrounded by an outside casing sufficiently strong to properly support the inner core and to resist the pressure of the strongest winds. The thickness of the walls of both the outer portion and the inner core should be sufficient to be very rigid near the ground and gradually thinner as the walls rise, the "breaks" being, of course, on the inside of the outer portion and the outside of the inner core. These breaks are usually four inches, or the width of a brick at each step. The "batter," or inclination of the outside face of the main structure should be a quarter of an inch per foot. In our case we are supposed to require a chimney 100 feet high, with a circular flue five feet in diameter.

In the sketches, Fig. 1 illustrates a vertical section through the center of the chimney and its foundation. It shows the thickness of walls, special form of central flue, retaining caps at the top, and special arrangements for increasing the draft. Fig. 2 is an elevation of the exterior, showing its general form and appearance when completed. Fig. 3 shows a horizontal section through the octagonal portion on the line *AA*, Fig 1. Fig. 4 shows a horizontal section through the square base, on the line *BB*, Fig. 1. Fig. 5 illustrates, on an enlarged scale, the number of bricks necessary for a course, if the square form were to be continued to the top. Fig. 6 shows the economy of adopting the octagonal form, as saving material and labor, and offering considerably less surface to wind pressure from certain directions.

In the Figs. 5 and 6 the upper half shows the laying of a "header" course and the lower half the laying of a "straight" course. In these two sketches it will be seen that in a header course, the octagonal form contains 52 bricks less than the square form; and in a straight course 32 bricks are saved. Assuming five courses per foot in height, and that in each foot we have one header course, we save by the octagonal form 180 bricks. This, of course, is less as we approach the top, but the average saving will be considerably over 100 bricks per foot, or over 8,000 for the whole work. Actual experience shows that the extra labor cost of making the many corners is more than balanced by the smaller number of bricks laid in the octagonal form than in the square form. The appearance is much enhanced and the wind pressure is considerably diminished by getting rid of the projecting corners.

The base of the chimney is of square form, this being more convenient for the introduction of the smoke flues or "up-takes" from the boilers, the placing of the ash doors and the general appearance. The ash door is shown in Fig. 2. The opening should be arched, preferably of semi-circular design, as affording the most strength to sustain the great weight of brick-work over it. It should be closed with a sheet-iron door. The openings for smoke flues should also be strongly arched, similar to the ash doorways. From the square portion at the base, the main shaft of the chimney is of octagonal form, as indicated in Fig. 4.

For foundations the earth should be excavated to perfectly hard ground, making a pit 28 feet square; that is, twice the depth of the foundation, assuming that in consequence of the condition of the ground it is necessary to excavate to a depth of 14 feet. In this pit should be a bed, 4 feet thick of large stones laid in strong cement mortar. Upon this should be courses about 18 inches thick and gradually drawn in at the top to 16 feet square. By strong cement mortar we mean that containing two parts cement, one part of lime, and about three parts of clean, sharp sand. The amount of sand will vary considerably with its fineness, sharpness and its freedom from dirt; the finer the sand the greater the quantity that must be used.

In erecting the central core and the outward supporting structure great care should be used to make all joints of uniform thickness, and to see that as the courses are laid on, they are frequently leveled. "Batter plumbs" should be used

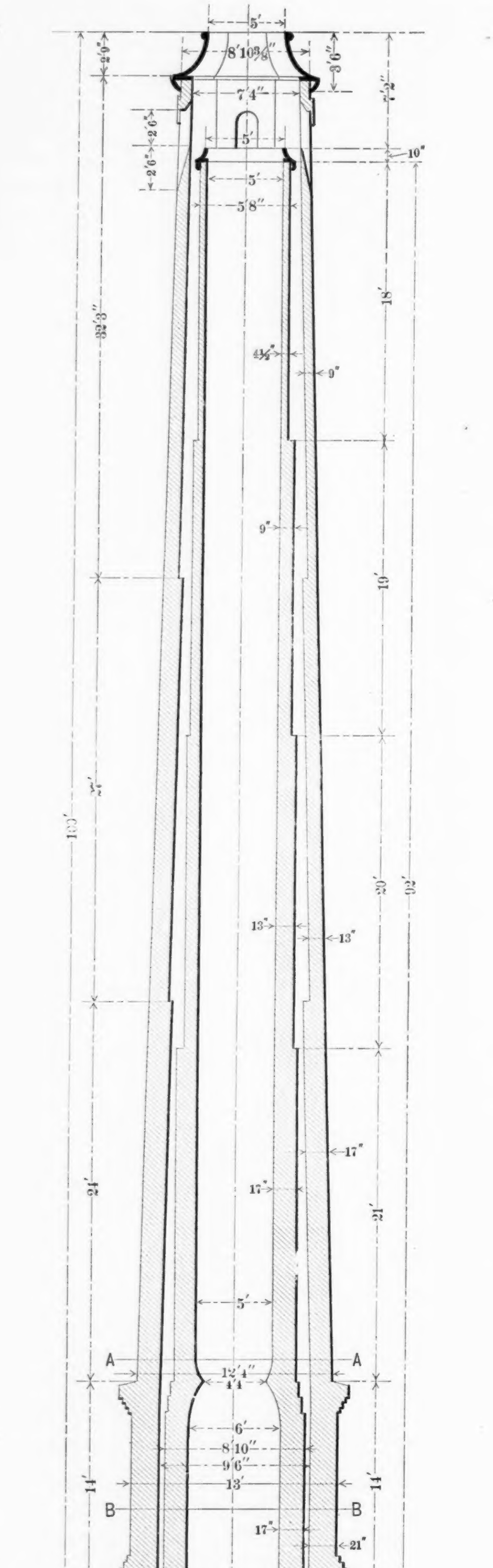


Fig. 1

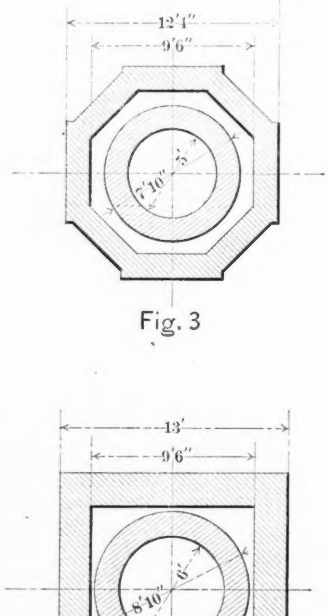


Fig. 3

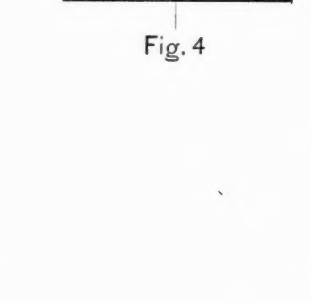


Fig. 4

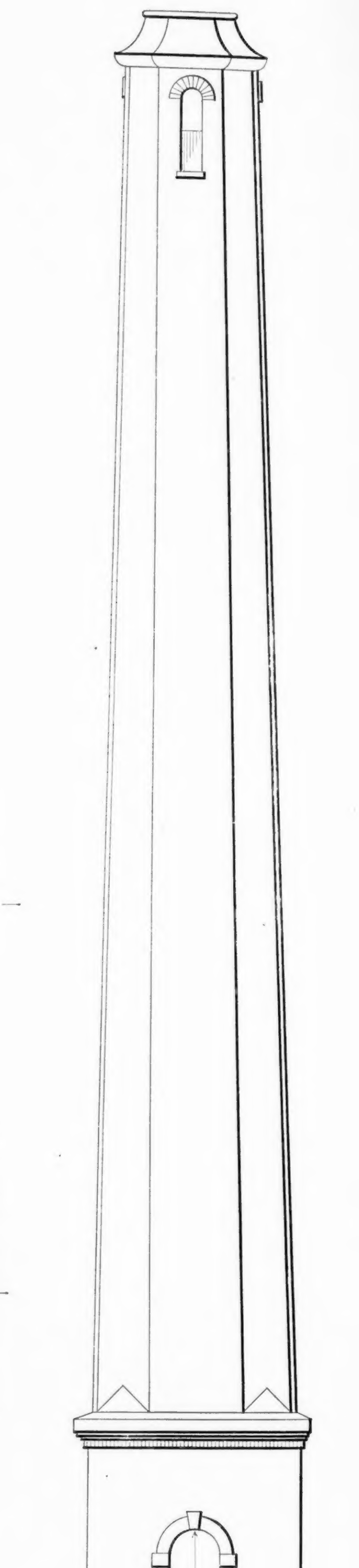


Fig. 2

Figs. 1 and 2. Sectional and Exterior Elevation of Chimney. Figs. 3 and 4. Horizontal Sections through A A and B B.

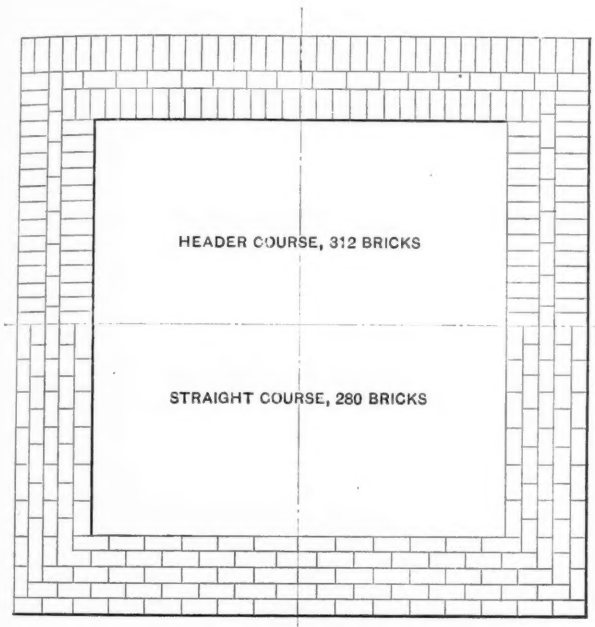
for the outside; that is, the board on which the plumb line is attached should have the batter or inclination by being made narrower at the bottom. For instance, a plumb board four feet long should be six inches wide at the top and four inches at the bottom (the batter being equal on both edges).

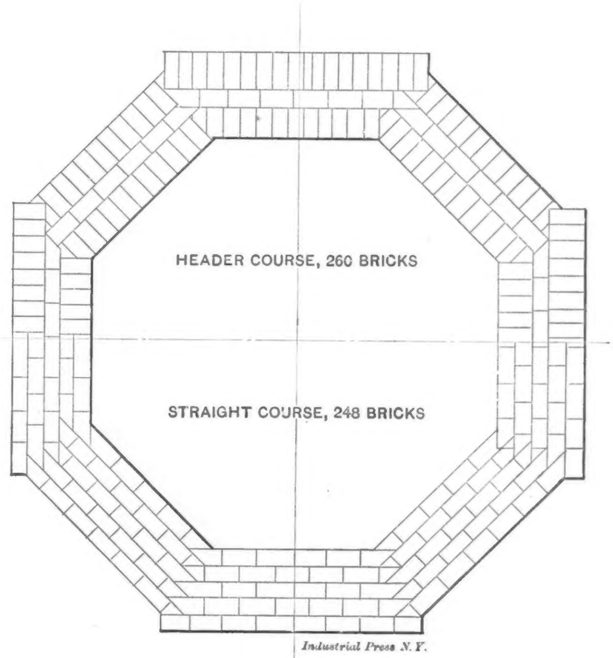
Another matter that must be scrupulously attended to is that of properly supporting the inner core. It will not do to lay bricks from wall to wall so as to tie them together, as the expansion and contraction of the inner core would soon ruin the structure. The support is given by building up into the outer wall inwardly projecting bricks reaching half way across the space, and against these, others projecting outwardly from the inner core. These should be placed on all eight sides, in the same course, and at intervals of not over eight feet through the entire height.

The form and thickness of walls and the heights of the "breaks" are shown in Fig. 2. The central flue is formed after the model of the well-known student lamp and forms a very effective combustion chamber for escaping smoke. It is the form adopted by a prominent engineer who built a large number of chimneys of this design which have been in successful use for many years.

The smoke flues enter the chimney below the constricted portion of the inner flue. The top caps are of cast-iron and may be made in sections and bolted together, as well for convenience in erecting as for economy of pattern making. That on the inner core terminates 7 feet 2 inches below the top of the main cap. At four sides of the outer structure are openings, as shown in Fig. 1, the bottom of each opening being on a level with the top of the inner cap. By this means the current of air which always rises along any high wall is taken advantage of, as it passes up the side of the chimney, into these openings, and out the top of the chimney, and creates a partial vacuum over the top of the central flue, thus considerably increasing the draft. Means should be provided for reaching the top of the chimney, as the iron caps will need painting, or lightning rods may have to be placed or repaired. Iron ladders up the side may be fastened to the wall, or a permanent block may be attached to the main cap and provided with a wire rope, for this purpose.

As a matter of safety from lightning it is well to provide lightning conductors. A round copper rod of not less than ⅝-inch diameter, or one of equal area of cross section, may be run up outside of the chimney, through heavy glass insulators, and terminate four feet above the main cap in four points, 5-16-inch diameter or equivalent area. The lower end of the rod should go into *moist* earth and be attached to a cast-iron plate 30 inches square and ¾-inch thick.





Figs. 5 and 6. Laying the Header and Straight Courses of Brick in the Square and Octagonal Sections.

STEEL AND ITS TREATMENT.—4.

HARDENING BATHS.

E. R. Markham.

When steel is heated to the proper hardening heat it is plunged into some cooling bath to harden; the rapidity with which the heat is absorbed by the bath determines the hardness of the steel. Knowing this, it is possible by the use of baths of various kinds to give steel different degrees of hardness and toughness. A bath that will absorb the heat contained in a piece of steel the quickest, will make it the hardest, everything being equal.

A bath of mercury will cause a piece of steel plunged into it to be harder than if the steel were plunged in any of the liquids commonly used for this purpose. But as a bath of mercury would be extremely expensive it is but little used.

Clear cold water is the bath more commonly used than any other, and for most cutting and similar tools gives good satisfaction; although many old hardeners claim better success with water that has been boiled, or that has been used for some time, provided it is not dirty or greasy.

A very excellent bath that is used almost universally is made by dissolving all the salt possible in a tank of water. Salt water, or brine as it is commonly termed, is used in most shops on certain classes of work and in some shops it is used altogether when a bath of water is desired.

Various kinds of oil are used to accomplish various results. When small or thin cutting tools requiring a hard cutting edge are to be hardened, a bath of raw linseed or neatsfoot oil is used. When toughness is the desired quality, as in hardening a spring, a bath of tallow, sperm oil or lard oil is used.

But the nature of steel of different makes varies so much that no one bath answers best for all purposes, or for the same purpose when applied to steels of different makes.

Sometimes it becomes necessary to use a bath containing two or more ingredients in order to accomplish the desired result.

I have in mind a manufacturing concern who made a great many heavy springs. Until they changed the make of steel they had been using for years they had excellent results from hardening in lard oil; but after changing they could do nothing with this bath. After considerable experimenting, they were advised to use the following mixture:

Spermaceti oil	48 parts
Neatsfoot oil	45 "
Rendered beef suet	4 "
Resin	3 "

They had very good results with their bath until a drummer came along with good cigars, and a steel 2 cents a pound cheaper, and then trouble was the result.

By the way, I have visited and known of several shops where a few good cigars, or an occasional wine supper, which some glib-tongued salesman was willing to put up for the man who did the buying, caused more trouble in the hardening department than a little.

But, to return to the hardening of the springs, when the *new* steel came, the springs would not harden satisfactorily in the mixture mentioned. They were finally advised to try a bath of boiling water and this worked very nicely.

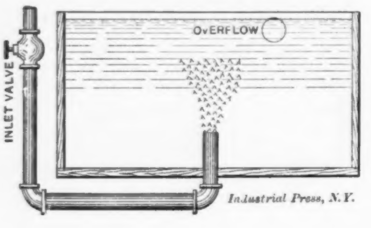


Fig. 1.

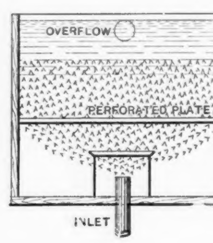


Fig. 2.

Very small cutting tools such as taps, reamers, counterbores, etc., harden very nicely in a bath made by dissolving 1 pound of citric acid crystals in 1 gallon of water.

The following bath is recommended where it is desirable to have the tool *hard* and *tough*:

Salt ½ teacupful; saltpeter ½ oz.; pulverized alum 1 teaspoonful; soft water 1 gallon.

The following bath gives excellent results, but care must be exercised in its use as it is deadly poison.

To 6 quarts of soft water add 1 oz. corrosive sublimate and 2 handfuls common table salt. When dissolved it is ready for use.

Sulphuric acid is added to water in various proportions from one part acid to ten parts water, to equal parts of acid and water—some even using clear acid. But although excellent results, so far as the hardened surface is concerned, may be obtained by employing this acid, steel makers do not advocate its use, claiming that the after effects are injurious to the steel. And the writer's experience substantiates the claims of the steel makers. I do not advocate the use of any of the acids which act on steel, provided any other form of bath will give satisfactory results.

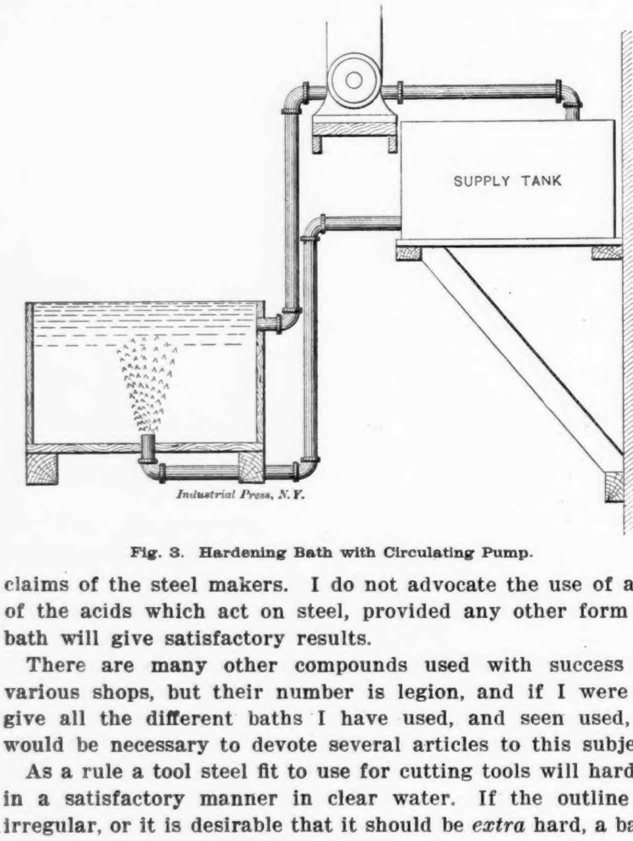


Fig. 3. Hardening Bath with Circulating Pump.

There are many other compounds used with success in various shops, but their number is legion, and if I were to give all the different baths I have used, and seen used, it would be necessary to devote several articles to this subject.

As a rule a tool steel fit to use for cutting tools will harden in a satisfactory manner in clear water. If the outline is irregular, or it is desirable that it should be *extra* hard, a bath of brine answers admirably.

Articles of an irregular shape, made of steel liable to crack when hardened, should be dipped in warm water or brine, the temperature of the bath depending on the liability of the piece to crack.

Such tools as milling cutters, made from high carbon steels, are oftentimes hardened to advantage in a bath of water having one or two inches of oil on the surface.The article is brought to the proper temperature in the fire and immersed in the bath, passing down through the oil into the water. Enough oil adheres to the red hot steel, especially in the corners of the teeth or projections, to prevent the water acting as suddenly as it otherwise would, thus doing away in a great measure with the tendency to crack.

It is a good plan when hardening large pieces of almost any shape, if they are first dipped in water or brine, to allow them to remain in this liquid until the surface is hard, then remove and instantly plunge in a tank of oil, allowing them them to remain in the oil until cold. This works especially well in case of such tools as cutters, punching press dies, etc., where it is not necessary that the hardened surface be very deep; the depth to which the piece is hardened depending on the length of time it is left in the water. For most purposes old hardeners allow the article to remain in the water until it ceases to "sing;" this is the peculiar noise occasioned by putting a piece of red hot steel in water. When the piece stops singing it is removed from the water, plunged into oil and left until cold.

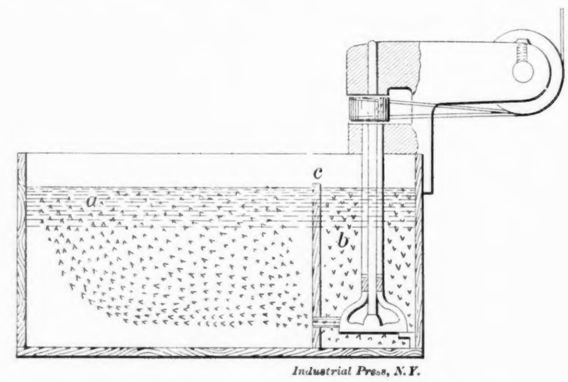


Fig. 4. Hardening Bath with Mechanical Agitator.

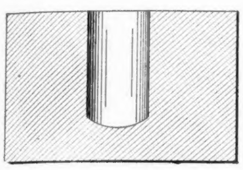
When pieces are to be hardened, and it is necessary to harden the inside walls of a hole or some depression, as the face of an embossing or forming die, or any similar piece, it is necessary, if good results are desired, to have a bath which has a stream or jet of water coming up from the bottom as shown in Fig. 1. If clear water is used in the bath, the inlet pipe may be connected with some constant supply, but if brine or some solution is used it becomes necessary to have a supply tank and use a pump, as shown in Fig. 3. The contents of the bath are pumped into the supply tank and run down the supply pipe by the force of gravity.

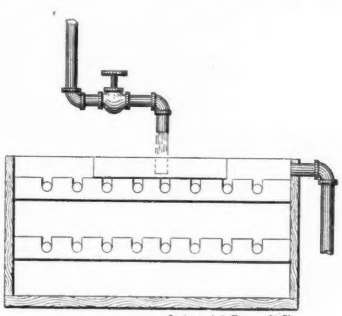
At times it is desirable to have a bath in which there is no gush or jet of fluid, but where the contents of the bath are kept in motion in order to force the steam away from the surface to be hardened. There are a number of ways of accomplishing this. Fig. 2 shows a bath having a pipe coming up from the bottom. The jet strikes a plate which spreads the fluid, after which it comes to the surface through the perforated plate.

Fig. 4 shows a bath in which the contents are kept in motion by some mechanical means contained in the tank. Such a bath may be made by following the instructions given in reference to Fig. 4. A tank of any convenient size may be made having a partition as shown at *c*; the portion of the tank marked *a* is intended to be used for the immersion of the articles being hardened, while *b* contains a pump, Archimedian screw, or some similar device for forcing the water into the side *a*. If a pump is used the water is forced through the pipe shown; if an Archimedian screw, the partition *c*, does not extend way to the bottom and the water is forced under it. In either case it returns to *b* over the top of partition *c*, as shown, thus insuring a rapid circulation of fluid. This form of bath is especially to be desired where brine or some favorite hardening solution is used. It is also possible to heat the contents of the bath when it is considered advis-

able, as is the case where articles are to be hardened that are liable to crack from contact with extremely cold liquids. Much more uniform results may be obtained, especially when small, thin pieces are hardened, if a uniform temperature can be maintained in the bath. As the surface of the bath is coated with ice in winter, the fluid is luke-warm in summer, and the temperature is anywhere between warm and extreme cold, depending on the condition of the atmosphere; it will readily be seen that uneven results must be the consequence. In order to be able to keep the contents of the bath at somewhere near a uniform temperature a small coil of steam pipe may be placed in the tank, and a thermometer may be used so as to readily show the condition of the bath.

While it may seem unnecessary to be so particular about the temperature of the bath—and it is unnecessary on most work,





Industrial Press, N.Y.

Fig. 5. Fig. 6.

as an experienced hardener can determine the temperature near enough by the sense of feeling—yet there are jobs where it is essential that a certain uniform temperature be maintained in order to get uniform results. I do not mean by this that it is practical to attempt to keep the temperature within a few degrees of a given point but it can be kept somewhere near in order to get the best results possible.

At times it is necessary to harden the walls of a hole that does not go way through the piece, such as a die used for compression work, or some forms of dies for striking up cylindrical pieces. Fig. 5 shows a sectional view of a die having a hole running part way through it, as described. Now, if a piece of work of this description were hardened in a bath whose contents were not agitated it is doubtful if the walls of the hole would be hardened in the least, as the steam generated would blow the liquid out of the hole and none could enter until the steel was cooled to a point where it could not harden. Better success would follow if it were dipped in a bath having a jet of water coming up from the bottom of the tank; but in this case it would be necessary to invert the piece in order to get the liquid to enter the hole, and if it were deep it is probable that enough steam would rise in the hole to keep the contents of the bath from affecting the walls near the bottom. Now, in order to get satisfactory results when hardening work of this character, it will be found best to have a bath so constructed that the liquid can be run into the hole by means of a faucet or pipe, as shown in Fig. 6. If the hole is deep and there is danger of the steam preventing the liquid effectually working at the bottom, a pipe may be run nearly to the bottom, as shown in sectional view, Fig. 7. The pipe must not be nearly as large as the hole or the results will not be satisfactory.

Sometimes it is necessary to harden several pieces of a nature whose outline betokens trouble if they are dipped in a cold bath, and yet it seems necessary to use a cold bath in order to get the desired result. Take for instance, a shank mill of the shape shown in Fig. 8. If this mill is heated to the proper degree of heat and plunged in a dish containing just enough water or other liquid to harden the teeth before the water gets hot, the teeth will harden in a satisfactory manner and the water will heat so as to do away with any danger of cracking from internal strains. The size of the dish will determine the depth of the hardening. When one piece is hardened the dish may be emptied and filled with cold water for the next. I have seen this method used with excellent results, not only on milling cutters, but on broaches, dies, etc., that showed a tendency to crack when dipped in a *large* bath of *cold* fluid. Of course, it must be borne in mind that the dish selected for the bath must be large enough to hold a sufficient quantity of liquid to harden the piece the necessary amount, before it becomes too hot; but it is essential that it should not be too large for the contents to heat, because then there is no difference in its action from that of a large bath.

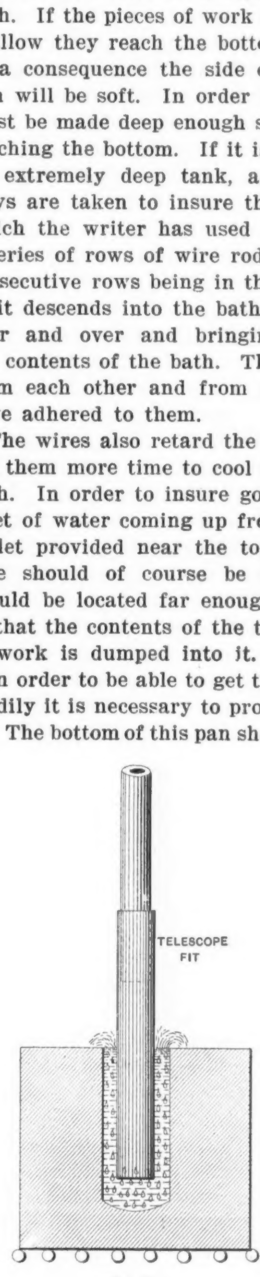
Baths for Case-hardening.

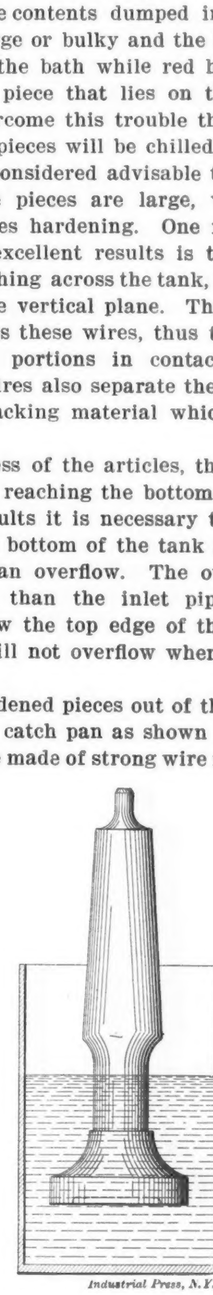
The design of the bath used for cooling work being case-hardened must be such as will adapt it to the work being hardened.

Where work is case-hardened in large quantities it is customary in most shops to heat the work in iron boxes; when the work is in the proper condition the box is inverted over a tank of water or other fluid, and the contents dumped into the bath. If the pieces of work are large or bulky and the tank is shallow they reach the bottom of the bath while red hot and as a consequence the side of the piece that lies on the bottom will be soft. In order to overcome this trouble the tank must be made deep enough so the pieces will be chilled before reaching the bottom. If it is not considered advisable to have an extremely deep tank, and the pieces are large, various ways are taken to insure the pieces hardening. One method which the writer has used with excellent results is to have a series of rows of wire rods reaching across the tank, no two consecutive rows being in the same vertical plane. The work as it descends into the bath strikes these wires, thus turning over and over and bringing all portions in contact with the contents of the bath. These wires also separate the pieces from each other and from any packing material which may have adhered to them.

The wires also retard the progress of the articles, thus giving them more time to cool before reaching the bottom of the bath. In order to insure good results it is necessary to have a jet of water coming up from the bottom of the tank and an outlet provided near the top for an overflow. The overflow pipe should of course be larger than the inlet pipe, and should be located far enough below the top edge of the tank so that the contents of the tank will not overflow when a box of work is dumped into it.

In order to be able to get the hardened pieces out of the bath readily it is necessary to provide a catch pan as shown in Fig. 9. The bottom of this pan should be made of strong wire netting





Industrial Press, N.Y.

Fig. 7. Fig. 8.

or a piece of perforated sheet metal, preferably the former. The holes in the pan allow the packing material to fall through to the bottom of the tank and will also allow the water from the supply pipe to circulate around the work and to the top of the bath. This catch pan should be provided with strong wire handles, as shown, in order to raise the pan.

I was at one time requested to call at a shop where they were having very unsatisfactory results with their case-hardening. An examination showed they were dumping their product into a barrel of water to harden. The box containing the work was inverted over this barrel and the work and packing material went into the water in a lump. Some of

the pieces that happened to get out of this mass were cooled sufficiently to harden somewhat but the majority of the pieces were soft, or else they were hard on one side and soft on the other. An examination of the bottom of the barrel showed it to be considerably charred; in places the outline of the pieces was plainly visible, where the pieces had reached the bottom while red hot and had burned their way into the wood. It is needless to say that the side of the piece of work which was down did not harden. As the concern did not think it advisable, considering the limited amount which they had to case-harden, to get a tank of the description shown in Fig. 9, we made a catch pan as described, blocked it up about 6 inches from the bottom of the barrel by means of four bricks. We then bored a hole through the bottom of the barrel, screwed in a piece of pipe and by this means we were able to connect an ordinary garden hose so as to get a jet of water coming

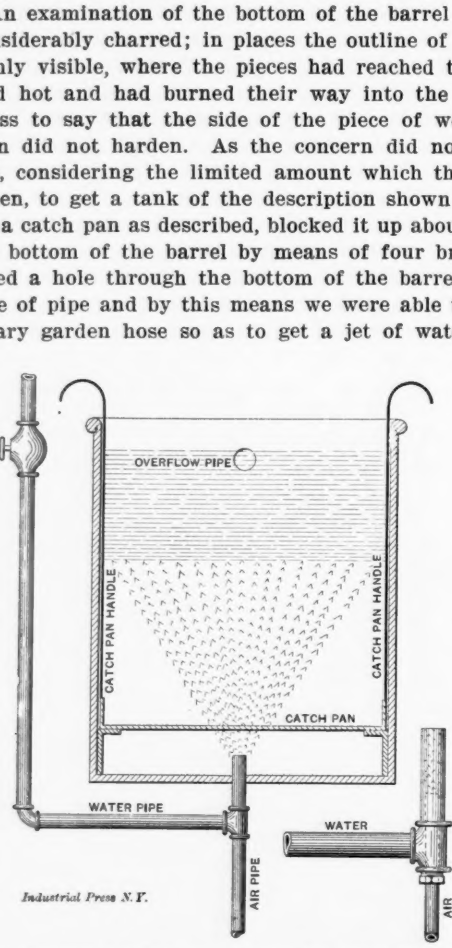


Fig. 9. Case-hardening Bath having a Catch Pan to facilitate removal of the Work.

up from the bottom. As the barrel was out of doors we simply bored a 2-inch hole about 4 inches from the top of the barrel for an overflow and let the water run onto the ground.

When the work was ready to dump we sifted it out of the box into the water gradually, instead of dumping it in a body. As soon as the box was emptied we grasped the wire connected with the catch pan and raised and lowered the pan in a violent manner in order to separate any pieces that might have lodged together. The result was very satisfactory and I think they are using a barrel to this day.

Where large quantities of work are hardened, baths are made with some means of keeping the work in motion after it reaches the bottom of the bath. Sometimes this is done by mechanically raising and lowering the catch pan and at the same time turning it around. Then again it is done by means of several sweeps which are attached to the lower end of a vertical shaft, the shaft resting in a bearing in the center of the catch pan. These sweeps or arms revolve and keep the pieces in motion, turning them constantly, but unless arranged properly they have a tendency to gather the work in batches thereby *undoing* what they are intended to do. Then again they have a tendency to scratch the surface of the work, which is a serious objection if color work is wanted.

When it is desired to get nice colors on case-hardened work, an air pipe may be connected with the bath as shown in Fig. 9, the water and air entering the bath together.

While it is not advisable to let air come in contact with pieces to be hardened for colors, while passing from the box to the water, yet the presence of air in the bath will have the effect of coloring the work nicely.

The air should enter in such a manner as to insure its reaching all parts of the bath. The pipe should be considerably smaller than the inlet water pipe and should extend a short distance up into it in order to prevent the air and water working against each other. A connection should be made as shown in detail. The writer does not suppose it will ever be necessary for many readers of MACHINERY to construct *all* the different bath tanks mentioned or find it necessary to construct these precisely like those shown. But some form or a modification of it will be found to fill almost any requirement in the ordinary shop.

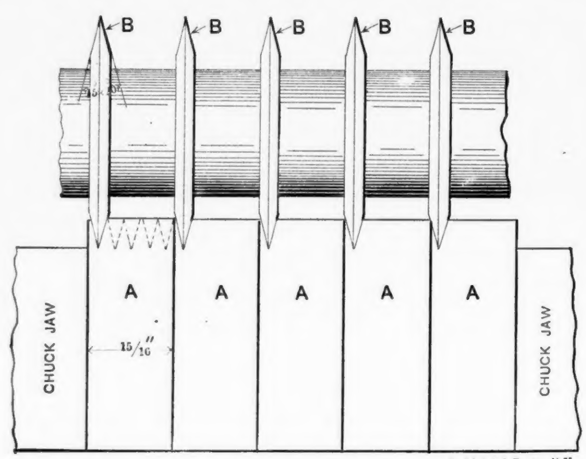
* * *

ANGULAR MILLING AND PLANING JOBS.

At the shop of the Falkenau-Sinclair Machine Co., Philadelphia (formerly A. Falkenau), an angular milling job was done recently that was somewhat difficult and out of the ordinary class of milling operations. More properly, in regard to the difficulty of the job, it was found practically impossible in one jobbing machine shop where it was tried, presumably because of inadequate fixtures; but it was comparatively easy when done with good tools and fixtures and in accordance with sound machine shop practice.

The job was milling five narrow angular grooves in one edge of a number of steel pieces 28 inches long, 2½ inches wide and 15-16 inch thick. The grooves were 3-16 inch wide and 5-16 inch deep and were carried to a sharp angle at the bottom. The steel pieces were for work of a special character the nature of which makes no difference in this connection except that it required the grooves to be quite exact and smooth, with no ragged edges at the tops. As indicated in the accompanying cut the sides of the grooves were sharply inclined, the included angle being 35 degrees. One side of the grooves made an angle of 20 degrees with the medial line and the other, 15 degrees.

In the shop referred to, that failed on the job, an attempt was made to mill the grooves successively with a single cutter while the piece was held in a milling machine chuck having narrow jaws. As a consequence the piece, of course, overhung the jaws a considerable amount on each side, which condition produced a peculiar result, but one that would have been predicted by anyone familiar with the characteristics of the stock used—cold-rolled steel. Cold-rolled steel has a surface under considerably more compression than the interior. In fact the interior is in a state of tension which causes the state of compression in the surface. If one side of a cold-rolled bar is planed off, the ends will curve toward that side when the clamping bolts are loosened. The first



A Job of Angular Milling.

groove was cut along one side and the second one next to it and so on until the last one, when it was found that the piece had assumed a rainbow shape and that the last groove cut was the only one that was straight, the others all having a curvature increasing up to the first one milled, which had the most. The explanation is simple, of course. The first cut reduced the amount of stock on that side and as the chuck jaws offered but little restraint the stock curved toward that side slightly, the curvature increasing with each cut. The remedy for this action was simply to use a heavy milling machine chuck having extra long jaws which embraced nearly the full length of the pieces and held them perfectly straight until all the grooves were milled. Then there was little or no tendency of the pieces to curve in either direction; and if they did slightly, the grooves would remain parallel, which was the principal consideration.

After it had been demonstrated that the grooves could be successfully milled, it was decided to mill a number at once, using gang cutters. Strange to say an eminent tool-making firm which furnished the cutters, recommended that the cutters be ranged side and side so that, say, the five grooves in one piece would be milled at one pass. This was found to be impracticable on account of the chips wedging between the cutters and causing rough, ragged edges at the junctures of the grooves; and the plan of mounting as illustrated, was adopted, the cutters *B, B, B, B, B*, being spaced apart the width of the pieces *A, A, A, A, A*, so that the successive cuts of each cutter were taken in each piece in the same relative position. This plan worked quite successfully.

In connection with the same contract a planer job of unusual character was done. It was grooving the top of a steel casting 16 feet long, 44 inches wide and perhaps 10 inches thick, with V-grooves of the same shape as those milled by the milling machine. The grooves were smaller, however, being about 20 to the inch. These grooves were planed with a gang tool, the cutters being spaced apart on the same principle as the milling cutters, that is, so that the chips of adjacent tools would not interfere. After the grooves were planed they were rolled, to produce a smooth surface, with a gang of steel rollers held by a holder in the tool-post. After rolling, the whole surface was polished with oil and emery, the workmen using pine sticks endways of the grain, for rubbers. A remarkable feature of this job was the freedom from blowholes, sand pits and flaws in the steel casting, the surface being perfect in this respect. It showed that steel founding has reached a high state of art in America when large steel castings of this shape can be made with a surface as free from flaws as rolled plates.

* * *

An Illinois Central Railroad freight car, fitted with ball-bearing axles, has been subjected to a test trip of 2,600 miles, carrying a load of 80,000 pounds. The results are reported to be eminently satisfactory, the balls and bearings showing no appreciable wear, and the car being ready for service without any repairs after the long trip.

NEW POLISHING ROOM OF THE BROWN & SHARPE MANUFACTURING CO.

Visitors at the plant of the Brown & Sharpe Mfg. Co., Providence, R. I., before the "new building" (building No. 4) was erected, have often been shown the grinding and polishing room in the basement of the main or No. 1 building. This, we think, was always considered a model of neatness and much superior in its appointments to the general grinding rooms. Since the erection of the new building, however, a new room has been equipped on the upper floor which is much superior to the old room and much more comfortable and convenient for the workmen. It is the lightest and cleanest polishing room we have ever seen, which fact will be appreciated by examining the accompanying illustration, Fig. 1.

The piping and general arrangement of the machines and shafting are indicated in Fig. 2. The polishing machines are of the same design as those illustrated in the Brown & Sharpe catalogues some years ago, but which they do not now

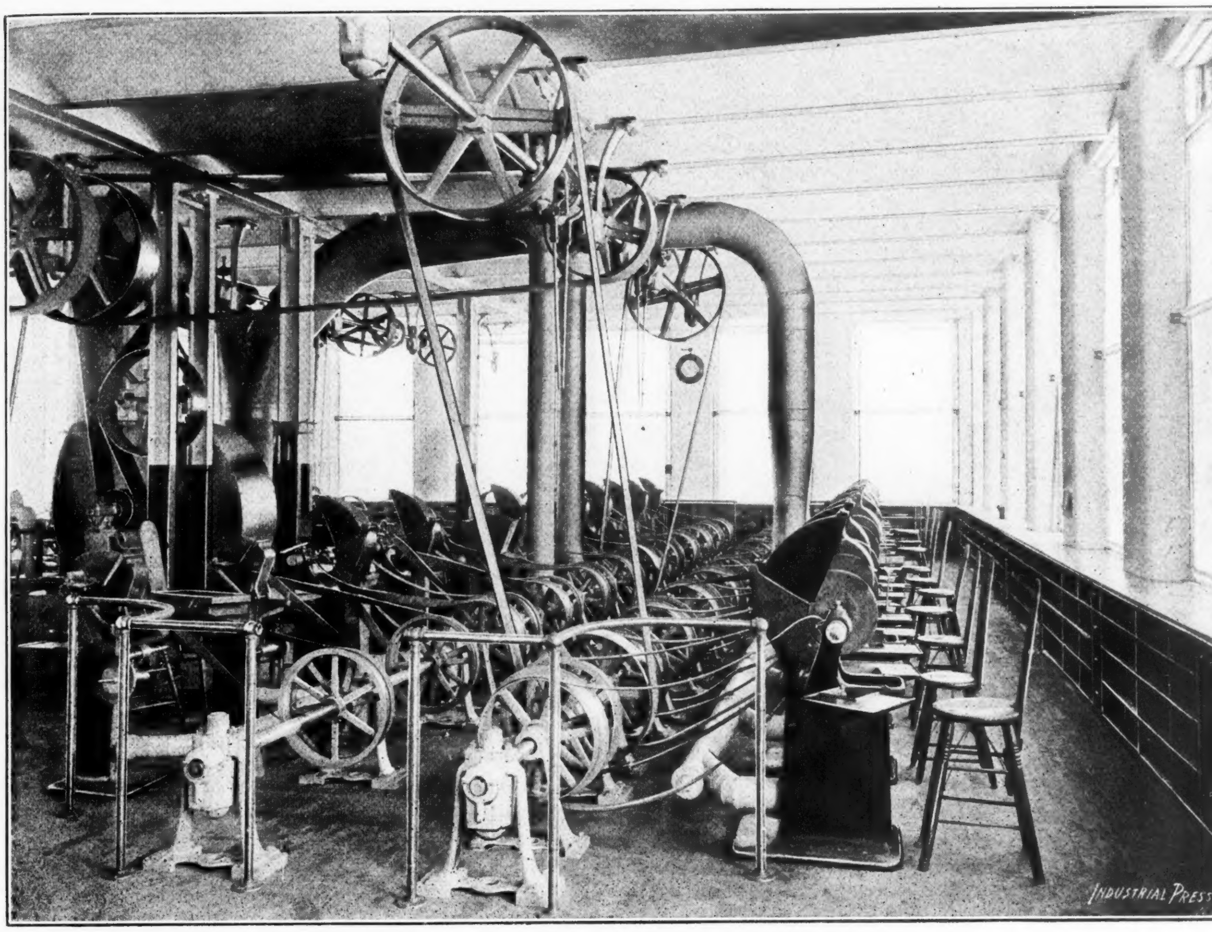


Fig. 1. New Polishing Room of the Brown & Sharpe Mfg. Co.

manufacture except for their own use, the machines now being handled by the Builders Iron Foundry, Providence.

The larger polishing machines shown in the foreground of the half-tone were especially designed with a view to economizing as much space as practicable. Ordinarily two machines are required, one running with an open belt and one with a cross belt, to enable the top of the wheel in one case, and the bottom in the other, to be used for polishing. In the machine mentioned, however, the horns for carrying the wheel spindle are located a sufficient distance apart to enable the spindle to be reversed. Each machine is provided with two sets of tight and loose pulleys, one set on each side, that carry open and cross belts, thus enabling the operator to use the same machine for polishing different classes of work that may require the use of the top or bottom of the wheel. The belt not in use is hung upon a hook provided for that purpose.

By this arrangement one machine answers for all kinds of work within its capacity, and does away with the necessity of the operator moving from one machine to another, thus

keeping his work always in one place, and economizing, because practically only half as many machines are required as ordinarily.

Another important feature is that the loose pulleys are not mounted upon the driving shaft but upon especially arranged bearings that are either upon an extension of the shaft bearing concentric with the shaft or (where the bearing does not come into proper position) upon especially arranged supports. It is obvious that this arrangement reduces the wear of the pulley bearings to a great extent, as they remain stationary and do not revolve upon the shaft. The machine columns are hollow and have hoods partially encasing the wheels, while the bases of the columns connect with exhaust piping leading to the large fan shown at the center in Fig. 2. The draft from the rapidly revolving wheels forces the dust around under the hoods where it drops to the bottom of the column and is then taken care of by the exhaust piping and fan exhauster. The dust is delivered by the fan to a separator on the roof, which finally discharges to a can or dust collector enclosed within a closet on the floor of the polishing room.

The separator and collector are of the well-known cyclone type. There are now 36 buffing wheels of the type described, in the room, the smaller ones being shown in the illustration, besides several belting machines which also have dust guards. Ample provision is made for wheel storage around the sides of the room and the equipment includes washing machine, sink, glue stove, an emery chest divided into compartments,

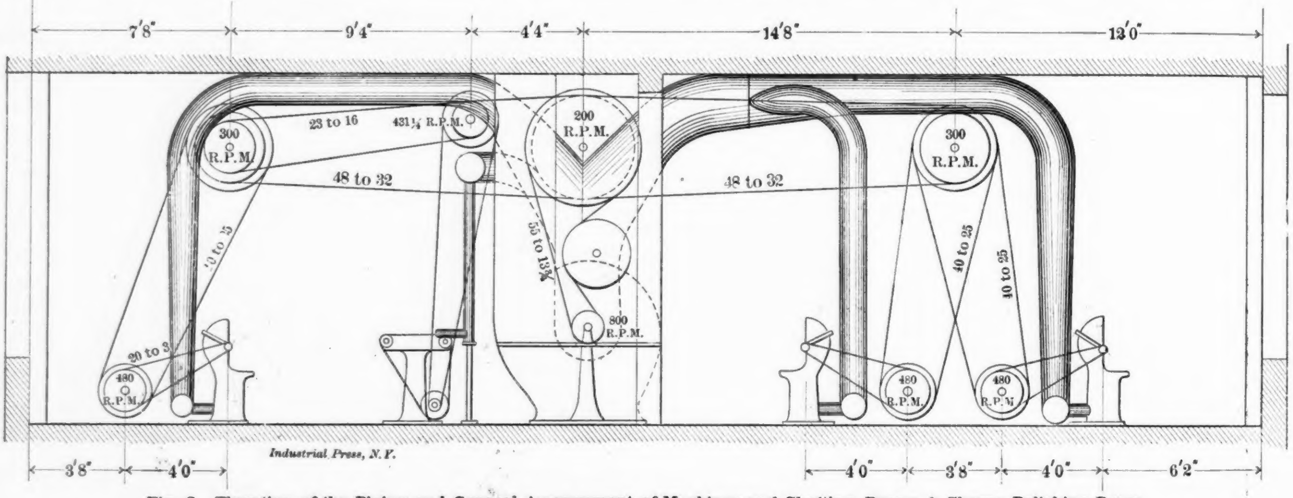


Fig. 2. Elevation of the Piping and General Arrangement of Machines and Shafting, Brown & Sharpe Polishing Room.

etc. The exhaust pipes are made in sections of different diameters, starting at 4 inches at the extreme end of each row of smaller polishers and at 5 inches at the ends of the row of larger machines; increasing to 10 and 12 inches, respectively at the center. It will be noted that a binder pulley is used for the belt driving the fan—a system quite generally followed throughout the works. The speeds of the different lines of shafting are indicated in Fig. 2.

* * *

Thomas C. Lace proposes that a color scale be adopted by the National Blacksmiths' Association for forging, hardening, tempering, and annealing carbon tool steel which for tempering shall consist of ten pieces of tool steel of convenient size, tempered from light straw down to the greenish blue of the color when the temper has run out. Nine of these pieces should be divided into three divisions, the first three for shades of straw color to brown, the next purple to blue, and the third, blue. He says that the lithographic color scales in existence are generally a bad imitation of tempering colors. The scale referred to would be a *fac simile* of what would be required for the guidance of the smith in every particular. The printed scales lack the metallic luster of tempered steel and there is no pigment known that will imitate it exactly. The forging, hardening and annealing heats could be imitated to a certain extent by paint or colored glass, but either is subject to the same fault of the printed tempering scale, that is, the translucent color of hot steel, is lacking.

PISTONS AND PACKING RINGS.—2.

SOME DEVICES FOR FLOATING THE PISTON ON STEAM PRESSURE—EFFECTS OF WEAR.

J. H. Dunbar.

Since writing the first article under this heading (July, 1902 issue), I have secured copies of several patents, showing plans for floating the pistons of horizontal engines on steam, instead of letting them ride on the bottom of the cylinder. There is no question but that a practical scheme to support the pistons is needed, nor that it will not be welcomed alike by engine builders and engine users. Just now the tail-rod is growing in popularity, but it is objectionable, owing to its taking up room and adding to the weight of the reciprocating parts, etc. These and other faults make it so far from being satisfactory, that there is plenty of room for something else, if the device is practical.

Before discussing these patented inventions, to be referred to later, it is well to remember that pistons are not steam-tight, in the sense of a safety valve. If there are such, the writer has not seen them. There are plenty of pistons, which if the cylinder head is taken off, and steam admitted behind the piston, will not immediately begin to leak, but after the pressure has been on, say five minutes, a little lake of water will be formed on the bottom of the cylinder, and as soon as the piston and cylinder get hot, steam will begin to sizzle around the piston at some part of its circumference. The actual leakage, when the engine is running, will be much more than when standing with the pressure on, for the friction of a film of water between metal surfaces is greater than that of a gas, between like surfaces. When the engine is standing with the pressure on, most of the leakage changes to water, owing to the thin space, and comparatively cold surfaces between which it must pass, while if the engine was running, it would to a greater extent, be steam. As illustrating the difference in leakage, between water and a gas, take a gas engine, turn it on the compression stroke to the center, or rather to the end of its stroke, and if the compression does not all leak out in less than thirty seconds, the piston is tighter than any that the writer has met with. Gas engines, as a rule, are very easy to turn, when the lead is off, and if the fly-wheel is "tramped" around leisurely, but very little resistance will be encountered, on account of compression. I think that for tightness, gas engine pistons will compare favorably with those made for any general purpose. If any engineer thinks his valves and piston absolutely tight, let him take a gasfitters' test pump and try to jam the cylinder full of wind, through the indicator pipe. Or let him clean the indicator piston and cylinder, then connect the indicator to a hand bicycle pump, and see how much pressure he can churn up against a hundred and twenty pound spring on the piston, using air as a pressure-producing medium. Then turn the indicator upside down fill the cylinder full of oil or water, then pump in air, and note the difference. Of course, in this, as in everything else, different experimenters will get widely differing results. There is one thing, however that they will all agree on, viz: That

the volume of leakage, under like conditions, is much greater with a gas than when a liquid is employed to produce motion in a machine, by pressure, or when acted upon by a machine to produce pressure. It is not much trouble to accurately determine the air leakage of a piston but it is different when it comes to steam. The writer knows of no satisfactory method of measuring the steam leakage of a piston when it is in service. Pistons that apparently leak only a little steam, do so enormously when used against air.

The first patent that the reader's attention is called to, in which the inventor's object was to make the piston swim in the cylinder, is shown, substantially as in the patent, in Fig. 1, of the piston. The packing rings are set obliquely in the head, are loose in the groove and so shaped as to act as check valves, i. e., when ring *A* is forced to the side of its groove marked *B*, steam can flow under and around it to the space between the rings, but not past ring *C*. On the return stroke, the rings change to the opposite sides of their grooves, and steam enters the space past packing ring check valve *C*. It will be noticed that there is more area on the bottom of the piston, between the rings, than on top, hence its tendency to lift when steam is admitted to it. The trouble and expense to make pistons and rings by this method, and the serious question as to whether the rings would act according to the

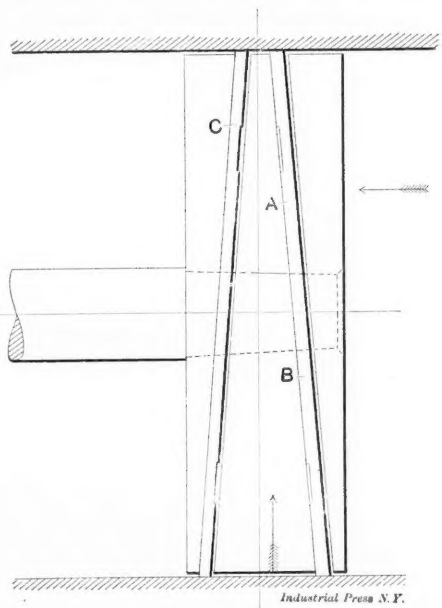


Fig. 1. Packing Rings set Obliquely to "Float" the Piston.

inventor's dictation, will stand between the invention and its popular use. Better results would no doubt be had, if the piston was run bottom side up, and as much steam as possible be kept from between the packing rings. The patentee is Mr. William J. Thomas, Sausalito, California.

Mr. Henry M. Hunt, Indianapolis, Ind., has patented an invention for counterbalancing the weight of the piston and rod of horizontal engines, by making the bull-ring with a cavity in the bottom and surrounding it with packing strips, and then keeping a constant pressure there, just sufficient to lift the piston. To do this he has a pressure-regulating device, inside of the piston, consisting of three helical springs, three valves and a diaphragm, with joints and ports to correspond. To make Mr. Hunt's invention more easily understood, and also to provide some means by which the steam may get on top of the bull-ring, and go down through it to the top of the diaphragm I have made several changes in his design.

Fig. 2 shows this invention. The cavity in the bull-ring is *t*, and *s* is the diaphragm, connected by toggle joint to the ball valves. This view shows the port holes *a* through the followers closed. When the pressure in *t* gets too low, the diaphragm drops and opens one of the ports, and steam flows in from the steam side of the piston, the hole in the opposite follower being closed. I show holes drilled through the bull-ring, near the top, marked *c*, in order to allow any steam that may get between the rings, to press the diaphragm down, and maintain a pressure in the cavity sufficient to carry the weight of the piston, and also the steam load on top of it. I do not see why, for horizontal stationary engines, an arrangement of this kind could not be made to just float a piston. On locomotives such pistons would do a lot of vertical hammering if they had any play at all in that direction. In general, they will likely be regarded as costly, unreliable and not adapted to piston heads made in one piece, the latter being the most important consideration.

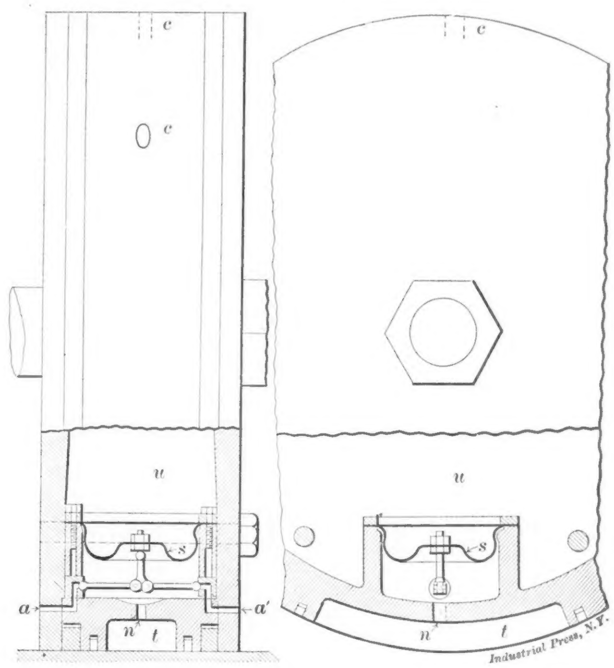


Fig. 2. Another Device for "Floating" a Steam Engine Piston.

In Fig. 3 we have what the inventor, Mr. James Thierry, Laramie, Wyoming, calls a "self-poising" piston. I have taken some liberty with this design too, by putting the counterbalancing cavities on the bottom of the piston, instead of on top where they are shown in the patent. I think that this inventor has made some mistake in his design, for with the cavities on top of the piston, there don't seem to be anything for the steam to do but to help hold the piston down. There are several patents, similar to this one as I have shown it, and all of them would be improved by some kind of a compensating device that would take care of the steam load and varying steam pressure on the piston.

As a parting shot at this part of the subject, I suggest making a piston as shown in Figs. 4, 5, 6 and 7. Fig. 4 shows an end view of it in section at the face of the rings. Fig. 5 is a vertical section through the center of the piston. Fig. 6 is an enlarged plan view of the joint, or cut in the outside ring *a*, and shows how the inside ring, *b*, stops any leak that would otherwise take place there, by the steam going in at one end of the lap, down under the ring and out at the other end. The flanges of the piston do not touch the cylinder at any part of their circumference, and are turned semi-eccen-

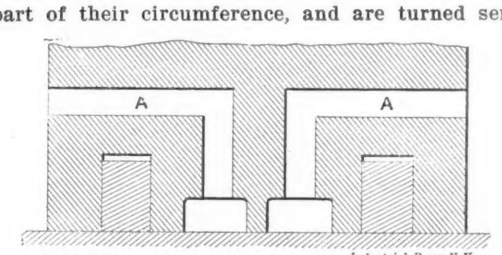


Fig. 3. Thierry's "Self-poising" Steam Engine Piston.

tric, so that as the ring *a* wears down they will still clear the cylinder; for it is intended to make the piston a steel casting of one piece, it being understood that steel and cast-iron do not wear well together, hence the flanges are relieved on the bottom. The outside ring, *a*, is cast iron, and made eccentric, and its thick side put at the bottom so the flanges can be cut away, and still leave about the same depth of bearing on the edge of the ring at all parts of its circumference. Ring *b* is made eccentric to give it a uniform groove contact.

Its thick side is up, and both rings are dowelled in their respective positions by pin *c* in the piston.

To equalize, or rather to get an average pressure between the ring and cylinder on all parts of their circumference, the bottom half of ring *a* is reduced in breadth an equal amount on each side as shown at *xx*, and in depth an amount equal to the eccentricity of the ring. The amount of side reduction depends on the weight of the piston, and the average steam pressure upon it. If the head weighs 500 pounds, is 20 inches in diameter and the pressure 100 pounds, then the width of the ring should be reduced on each side; would be $500 \div 100 \times 20 = \frac{1}{4}$-inch, making a 20-inch ring 2 inches wide. on top, and the bottom half $1\frac{1}{2}$ inch wide. Now the steam pressure on the outside of the ring where it has been cut away at *xx*, tends to collapse it, and not to lift the piston bodily. The tendency to collapse the ring under such circumstances would be about as great as though the ring traveled over the counterbore $\frac{1}{4}$ inch. Were it not that some steam gets under the rings to hold them out to the cylinder, it would not do to let them travel past the counterbore, as is generally done. Suppose with our 20-inch piston, the pressure at the beginning of the stroke is 200 inches, then its tendency to collapse the ring vertically is $\frac{1}{4} \times 20 \times 200 = 1{,}000$ pounds, but if there is four times the area on the inside of

It is shown in Fig. 5 so wide that possibly not enough steam will get under it from space *e* to keep both rings from collapsing. In Fig. 6 it is only wide enough to cover the cut in *a*, which of course limits its breadth in that direction.

It seems, too, that the weight of a 20-inch piston, say 500 pounds, having a bull-ring surface of $2\frac{1}{2}$ inches wide and 15 inches chord length, in contact with the bottom of the cylinder, ought not to cause any appreciable wear, due to its weight only; for when spread out, it is less than 14 pounds to the square inch, certainly not enough to pay to put on a tail-rod. If however, in addition it has to carry a steam load on one flange, and whatever may get on top of the bull-ring, it is different. If the flanges and bull-ring are cut away so that they are balanced, so far as steam pressure is concerned, then a tail-rod may be of some use, provided it is stiff enough to carry the piston without too much deflection. If the flanges and bull-ring are not relieved, the bottom of the cylinder is worn to a circle, whose radius is determined by the amount the piston and tail-rod will deflect. Without a tail-rod, it does not make much difference to the piston if the crosshead does lift a little at each end of the stroke, as a locomotive does in running ahead, but if a tail-rod is used the piston gets an unnecessary amount of shaking up and down.

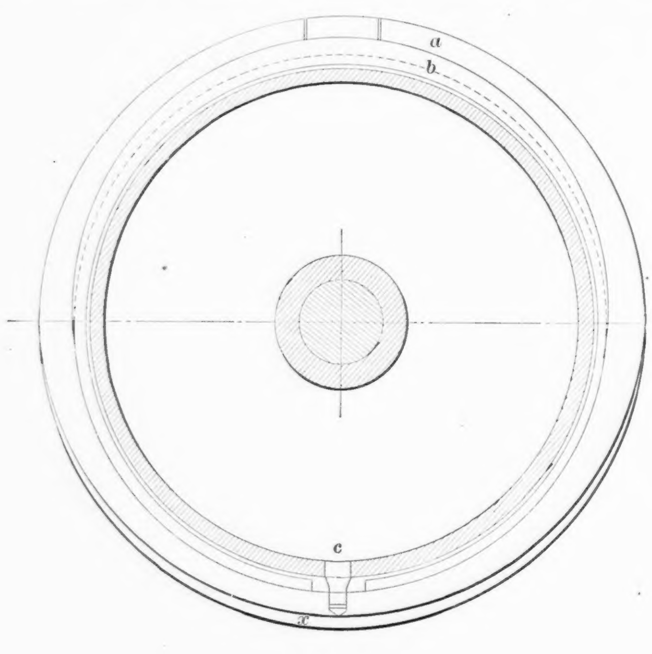


Fig. 4.

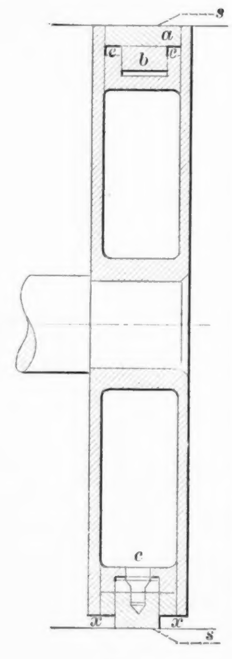
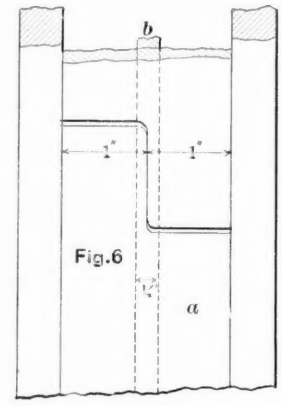


Fig. 5.



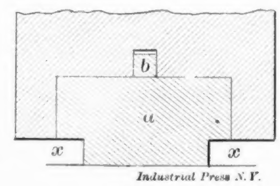


Fig. 7.

the ring, and one-fourth the pressure, the collapsing tendency is just balanced, but the total pressure between the ring and cylinder is 500 pounds more on the top half than on the bottom, and consequently, the top half of the ring and cylinder will be worn the most. Suppose further, that the engine takes steam full stroke, and that the 200 pounds are maintained and also that the wear is proportional to the load, making the top half of the ring wear twice as much as the bottom, say $\frac{1}{4}$-inch and $\frac{1}{8}$-inch respectively. The piston, as a whole, has gone down just as much as the bottom of the ring and cylinder, has worn, but never had a tendency to lift, nor can it unless the ring collapses.

I feel safe in saying that unless a ring is so tight in its groove that it is liable to stick, more steam will get under it than is necessary to prevent collapsing. Of course, rings can be run so far over the counterbore that the external pressure might exceed the internal pressure, but there is no necessity for it. A 1-16-inch over-travel is enough, and in general there does not seem to be any use for more. The dotted lines *ss*, in Fig. 5, represent the counterbore, and show the proportionate distance the rings should travel over it.

Ring *b* in addition to covering the joint in *a*, confines to a great extent, the steam to one end of ring *a*, holding it in space *e*, thereby lessening ring and cylinder wear, and consequent friction. Its width (ring *b*) will depend on circumstances, but as a rule one-half the breadth of *a* will be best.

Near the close of the first article on this subject, I implied that one ring to the piston was enough, and so far as ring and cylinder wear is concerned, the piston I have shown in Figs. 5 to 7 may be called a single-ring piston. There are some advantages that a piston of this type has over those with a ring at each end of the piston as shown in Fig. 8. To make it clear, the "deformity" has been somewhat overdrawn, for stationary practice, but locomotive men will recognize it as "true to life." In the sketch, the flanges are reduced in diameter so the weight of the piston is borne by the bull-ring, the packing rings having a liberal amount of vertical play in their grooves. It is evident that if one ring wears the cylinder any at all, one more will wear it a like amount, and the bull-ring will probably wear the bottom of the cylinder as much as both packing rings. So it is easy to see that that part of the cylinder which is traversed by all the rings, must suffer more wear than at the ends of the stroke, where only one of the end, or outside rings touches it, making the shoulders as shown at each end of the cylinder. If wear is proportional to pressure, and only one ring at a time has pressure under it, a single ring would wear the cylinder as much as both those in Fig. 8. But that is questionable, and in the high-pressure cylinders of multiple-expansion engines, there is pressure on each side of the pistons, but the most unnecessary wear in two-ring pistons would be due to a trifling leak of one ring that would let enough steam through and get

under the other. There is often but a few cubic inches of space between the rings in pistons, and when that gets full of water, an insignificant amount of leakage from the live steam side of the head may keep the pressure between the rings, equal to that on the piston. It was shown in the first part of this article that steam may leak considerably, where water will not, hence if this theory holds good, an objectionably high pressure will be constantly between and under the rings. It seems clear to me that the better the rings fit in a two-ring piston, the more pressure will be maintained under them, and the more wear and consequent friction will be produced. If both rings leak plentifully, the pressure under each of them will be less. Water has no trouble in getting out if the hole is big enough.

It will occur to the reader that the wider a packing ring is, after some economical width is exceeded, the greater frictional resistance it will produce. Were it not for the steam pressure that gets under it, making the load to carry proportional to its area, the width of rings would be in the same class as journals, crossheads and other bearings. As it is, ¾-inch is believed to be as good a breadth as any, for diameters of 20 inches and over. Under that diameter, ½-inch, ⅜-inch, ¼-inch, etc., will be found to be satisfactory. Rings should always be made wide enough so the piston will strike the cylinder heads, before the rings can get into the counterbore. For a single-ring piston, where the weight of the head is

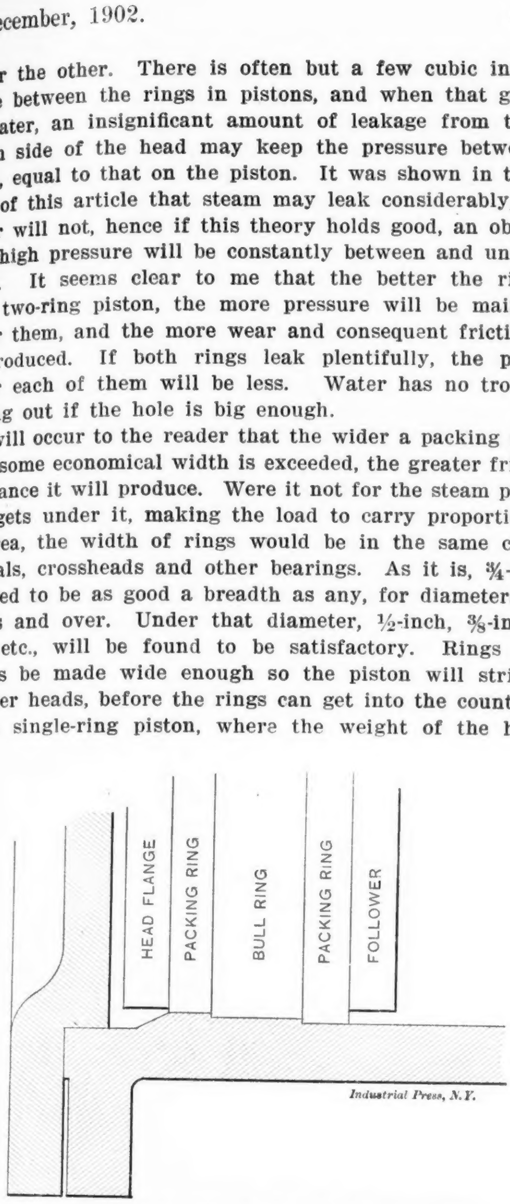


Fig. 8. Showing the "Step" Effect of Packing Ring Wear.

carried on the ring, it ought of course be made wider than the regular two-inch width. For the piston shown in Fig. 5, ring *a* should be 1 inch wide at the bottom, 1½ inch wide at the top, and ring *b* ½-inch wide, and edges parallel. Steam will of course get under the outside ring at the cut, if at no other place, and probably under the inside one too, but there will be no pressure higher than that of the exhaust in space *e* on that side, for any pressure that gets in from the live steam side can get out easily by the same route when the exhaust takes place. Taking the weight of the piston into consideration, this combination of ring widths, would wear a cylinder about as much as one ¾-inch ring in a piston of like diameter supported on a tail-rod. It will be noted that the flanges of the head in Fig. 5 are considerably smaller than the cylinder, and that the pressure on the edge of the ring will keep it against the exhaust. The rings ought, of course, to be as close a fit in their grooves as practical, and also have smooth, accurate surfaces. Then the only time they will have an excuse for leaking will be when they are shifting in the grooves, which they will do when the pressure is about equal on both sides of the piston. If there is any difference in the amount of play, the outside one should have the most, to make sure that the edges of the inside ring make joints in its grooves. As regards leakage, the edges of ring *a* are not important, but its circumferential surfaces are.

The question of lubrication is always closely allied to any moving part of a machine, and while there are other parts of an engine that may be of more importance, there are none that are oiled in such a bungling manner. It is stationary practice to turn a drop of cylinder oil loose in five or six barrels of steam, somewhere between the boiler and the engine, and then it is a case of "go as you please" until it is filtered out of the exhaust, when it is cooked over again. When the supply is liberal, as it usually is, enough of the oil finds the parts to be lubricated, and excessive wear is seldom found. When it comes to lubricating locomotive cylinders it is different. There they allow a drop of oil to every few miles the engine runs, or a few drops to the round trip, I have forgotten which. The oil and steam are mixed the same way as in stationary engines, but the homeopathic doses of oil administered to the steam used in the locomotive, are too often rushed through to the smokestack, without having time to get sidetracked on the cylinder. Now if there is any law of friction that is not befrilled and festooned with strings, it is the one that wear and frictional resistance are greater between dry, than between lubricated surfaces. I believe that this law is as true as it is that two trains cannot pass on a single track, and yet some railway managers offer their engineers a premium on the oil that they save. This puts me in mind of a picture the Jones & Lamson people have in their catalogue, of an old party with a microscope, looking for a leak in the head of a barrel, while the bung-hole at the bottom is wide open.

* * *

THE VALUABLE MAN OF THE FUTURE.

In a handbook recently issued by the New England Association of Teachers of Metal Work, containing addresses given before that association, in a paper on Hand Work in Modern Shop Practice, by our contributor, Mr. Edward R. Markham. He comments on the modern tendency to manufacture as cheaply as possible by means of machinery, and to abolish hand work, and closes with a bit of personal reminiscence. He says:

> Young men learning the trade are not, as a rule, taught to become skilled filers, or scrapers, and less is taught them about the use of the cold chisel and hammer. Any work of this nature is left to the "old fogies" who are considered oftentimes as being good for nothing else.
>
> In time these older men will have finished their shop work, and as machines are built that require in some of their details very accurate hand work, who is to do it? Not the average young journeyman, or the apprentice learning his trade in most of our machine shops. There are exceptions to the conditions I have cited; there are employers who realize the conditions that must face them in a few years, and are educating their young men in lines that will allow them to fill that gap that must come. But these employers are the exception rather than the rule. I predict that in less than twenty years the machinist or tool maker capable of doing good hand work will be at a premium. He will not have to depend on any organization to keep up the standard of wages for him. He will be able to demand any reasonable compensation. The law of supply and demand will attend to his case.
>
> I learned my trade under my father. He is one who believes in teaching a boy as *much* of a trade as possible. Many days, weeks and months have I stood at the vise with file or hammer and chisel in my hands, and worked and growled because I was made to do things that boys in other shops knew nothing about. But many, many times have I been thankful that my father knew more than I thought he did.
>
> There have been times when I doubted the advantage of having been able to command the confidence of the boss to the extent that he would trust me to go down into the wheel pit, and, with chisel and hammer as weapons, and a tallow candle for my light, chip a keyway in a jack shaft; or, tell me if he would like to have me stay a little while in the evening and cut another in the main line. It isn't all fun, sitting straddle a line of shafting and chipping a slot one-half inch wide and six or eight inches long, especially when you haven't room to swing the hammer, and must give the force of the blow by main strength rather than by the haft of the hammer head. But it had to be done and the man that can do the unusual things about the shop is the valuable man.

* * *

Rock blasting extraordinary has recently been done in Wales. One blast in the Trever quarries, Carnarvon, brought down 60,000 tons of rock, and 12,500 pounds of powder were exploded. The other blast was still larger, it being estimated that 100,000 tons of rock were dislodged. This blast was made to secure material for the building of a breakwater at Goodwick, Pembrokeshire. Only 10,500 pounds of powder were fired, yet the amount of rock is greater than in the other case, probably being the largest ever brought down by one blast.

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DECEMBER 1902.

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Election day has come and gone and the usefulness of the voting machine has again been demonstrated in no uncertain manner. The first voting machine tried in New Jersey was used in Paterson the last election and with very gratifying results. The result was known ten minutes after the polls closed. In other districts the poll clerks worked hours, in some cases until five o'clock the next morning before the last ballot was counted. The voting machine is the one "machine" in politics that all good citizens may unhesitatingly indorse. It saves time in voting and counting, and insures the secrecy of the ballot. The cost of paper and printing for tickets used and unused in every election, is alone an item of considerable importance. The voting machine has come to stay.

* * *

GRAPHITE VS. FRICTION.

We have occasionally had inquiries about the use of graphite as a lubricant and points have been brought out through correspondence that may be of interest to the general reader. The action of graphite is somewhat different from that of fluid lubricants and there are differences of opinions as to the part it is capable of playing in alleviating friction, some contending that graphite is not properly called a lubricant, and even that it has abrasive properties, unfitting it for use between bearing surfaces. This latter opinion was recently expressed to us by a person who had been engaged in testing lubricants, but who, possibly, may have been somewhat prejudiced in the matter.

According to the strict definition of the term, graphite is rightly called a lubricant. The term is derived from the Latin *lubrico*, meaning to make slippery, a result certainly accomplished by graphite. While we have not had opportunity to verify the statement that graphite has abrasive qualities, it is very evident that the results from this action are so slight as to be negligible in practical work. We are inclined to the opinion that, if abrasion has actually been observed, it is due to the presence of foreign substances rather than to the graphite itself.

The crystalline, or more commonly called flake graphite, is the kind most suitable for bearings. It is composed of flakes of irregular circular shape, about 1-40 inch in diameter and varying from .002 to perhaps .0002 inch in thickness. The formation is very similar to that found on a large scale in slate quarries, where the slate breaks up readily into thin slabs, entirely similar to the minute flakes into which graphite separates.

The function of graphite is not so much to take the place of lubricating oil or grease as to make the surfaces of the wearing parts smooth and polished so they will slide over one another with as little friction as possible. For this reason it is perhaps misleading to call graphite a lubricant. The result accomplished by it is analogous to the result obtained by the use of the modern grinding machine when finishing journals or bearings. If the journal of a rotating piece is finished by turning or filing, simply, and is soft, it will take more power to rotate it in its bearings than if the parts are hardened and ground, and accurately cylindrical. Friction is caused by the slight irregularities of surfaces fitting into one another, and so requiring force to make one slide upon the other. Grinding reduces these irregularities and when we come to a surface as smooth as ice the friction is very little indeed. Graphite accomplishes practically this result. It fills up the pores and produces a smooth surface, in just the right condition for a bearing, and as the coefficient of friction of graphite is only about half that for iron or steel, its value in a bearing is very manifest.

While graphite is seldom used as a lubricant without oil, its low coefficient of friction makes it a fairly efficient lubricant when employed without oil, or when for any reason the oil has become dissipated, leaving a graphite coating on the wearing surfaces. Such a condition might exist in a gas engine or superheated steam engine cylinder, or a heated bearing, if the temperatures were high enough to vaporize the oil. It is well known that graphite will "cool off" a hot bearing, for the reason, of course, that it makes smooth surfaces out of the roughed-up ones; and in a similar way, and on the plan that prevention is better than cure, its previous use will tend to prevent a bearing from roughing up and heating. It is more effective on rough than on hardened and ground surfaces and is generally considered very efficient for heavy work, where it is not liable to be squeezed out from between the surfaces by the great pressure. But there are cases where it is decidedly better for light work than oil; for example, in the runways in the Mergenthaler linotype machines. In these the matrices from which the letters are cast are of brass or composition, and upon the depression of the keys on the keyboard they slide down inclined grooves to their proper positions for the casting of the line of type. Were oil used to lubricate the grooves, it would gather dust and the matrices would stick, a difficulty not experienced with graphite.

Graphite is almost indestructible. It is pure carbon and is not attacked by acids and will protect metallic surfaces from corrosion. It is used by many machinists when putting together machinery that must be exposed to the weather, such as locomotives or hoisting machinery. In these cases, if the screw threads and surfaces in contact be coated with a film of graphite and oil, the parts will not rust together and can be easily taken apart when occasion requires. In steam and gas engine cylinders graphite is not as generally employed as would be the case if it were easier to automatically feed it into the cylinders, as is done with oil by the use of the sight-feed lubricator. Many devices have been invented for the purpose, however, and some of them are proving quite successful.

Graphite is efficient in reducing friction and its use is increasing as its merits become better known and the way in which it operates is better understood. No more striking illustration of its qualities can be given than by mentioning a peculiar incident related by Mr. Malcolm McNaughton, of the Joseph Dixon Crucible Co. In India, where graphite is mined, many houses have tiled roofs. These are of the simplest kind, having no locking devices for holding the tiles, which are laid loosely on the roofs. The angle of the roofs is less than the angle of repose for the tiles. The winds carry the dust from the plumbago compounds and drive it into the crevices of the roofs; and in some cases the angle of the roofs has proved too great under these conditions and the tiles have slid to the ground, whereas, were it not for the graphite they might have remained on the roofs for years.

NOTES OF TRAVEL.

CUTTING SPEEDS—DESIGN AND FINISH OF GERMAN AND SWISS ENGINES—SAND BLAST.

Editor MACHINERY:

Although high cutting speeds and heavy cuts for machining iron and steel have been used for some time in the States for heavy work, and the "blue chip" is now well known in the roughing-out process of heavy forgings, little attention seems to have been given to the use of the most recent special steels for rapid machining of small work. In bicycle and automobile construction the steels used for cutting tools have been driven to the utmost service by the aid of copious floods of oil, soda water, emulsions and other liquids for cooling the tool and the work. But the steels used were those which softened at comparatively low temperatures relatively to the high temperatures that the recent steels will withstand. The work done by a cutting tool was much less in a given time than is obtained with special steels.

In the works of Alfred Herbert, Limited, Coventry, England, builders of light machine tools, special steel is used on the milling machines for inserted-tooth mills, turret and capstan lathes, engine lathes, planers, shapers and other machines for performing like services. The small tools are made of "A. W." (Armstrong-Whitworth) and "Magic" steel. During a three-hour inspection of the works, the writer observed that the machines were running at very high speeds and removing metal with great rapidity. Finally an engine lathe of a swing of probably twenty inches was noticed turning off a shaving from what, on account of the white, straight chip, appeared to be lead or something of the nature of babbitt metal. A remark to that effect, however, elicited the information that it was a piece of mild steel undergoing machining, and an examination proved this to be the fact. The cutting tool was "A. W." steel. The cutting was done dry, without the use of oil, soda water, emulsion or anything for cooling the tool and work. The chip showed no color due to heating and the tool kept sharp and made a clean, smooth cut.

A notice posted about the shops, giving instructions as to cutting speeds and feeds, was read later. It is given below from a copy kindly furnished by the company. An idea of what is done can be had by reading it.

The machine tools built at the Herbert Works for this high duty are very heavily proportioned for the service to be performed. They are a combination of what is best both in American and English design and construction. Wide belts are provided for, a feature lacking in many machine tools.

On the whole the visit conveyed a most favorable impression.

Copy of Notice Posted at the Albert Herbert, Limited, Works.

NOTICE.

Trials have been made in these works of tools made of "A. W." steel, and the following tables are intended to show the amount of work that can be done. The tools will work two or three hours at these speeds and feeds. Speeds and feeds much in excess of those given can be used for a short time. A small stream of suds was used when cutting steel; more work can be done with more suds. These tools must in future be used wherever possible.

Reduction on Diam. Inches.	Feed per Inch.	Cutting Speed. Feet per Min.
Cast Iron.		
1-16	32	85
3-16	32	80
¼	32	75
Mild Steel.		
1-16	32	100
⅛	16	90
¼	16	85
⅜	32	80
Cast Steel (No. 8 and Tool Steel).		
⅛	32	50
¼	32	40
¼	16	20

Design and Finish of Steam Engines in Germany and Switzerland.

The great simplicity in the design and finish of steam, gas and oil engines in Germany and Switzerland is strongly impressed upon one by a visit to the machinery department of the Düsseldorf exhibition, Germany, and the great engineering plant of Gebrüder Sulzer (Sulzer Brothers) at Winterthur, Switzerland. Ornamental additions are entirely absent. Cylinder lagging, safety guards and oil shields are made of heavy Russian sheet iron banded, supported and strengthened where necessary with polished steel which is often given the same color as the Russian iron. Even oil cups and other trimmings show no polished surfaces in some cases, at least the surface is not left the color of the alloy. Polished and blackened brass, or polished iron is largely used for these parts. And finally the frame, bed and other cast iron or steel casting parts have their surfaces well filled by the painter and finished to a smoothness and color resembling very closely the Russian iron. The moving parts are polished either wholly or over a considerable portion of the surface, and left bright. The machines are well proportioned, free from sharp angles and projections, and consequently beautiful in their simplicity and strength. They are pleasing to the eye in the same way as a magnificent horse free of all harness and trappings, and convey the impression of strength in the same manner.

Sand-blast for Castings.

The sand-blast for cleaning castings of medium size finds considerable favor in Germany and Switzerland. Castings small enough to go into the ordinary foundry tumbler or rattler are cleaned by the common method of tumbling. The sand-blast machine used for the medium size pieces is entirely different from any the writer has seen or heard of in the States. It is not in any respect similar to the sand-blast nozzle, hand guided for cleaning large castings, and does not take its place. The continental machines on exhibition in the Düsseldorf exhibition and in operation in various industrial establishments were made by Alfred Gutmann, of Ottensen, Hamburg. They have a horizontal circular table about six or seven feet in diameter which rotates slowly about a vertical spindle. The whole machine resembles in a way a horizontal table boring and turning mill. Two blasts of sand are blown down upon the back half of the table, which part is covered over with a sheet metal guard to prevent flying of the sand. The pieces to be cleaned are placed on the table which carries them under the sand-blasts by its continuous rotation. The table is of cast-iron grid construction to allow the sand to fall through. An attendant for one or two machines is required, for turning the castings over at intervals during the constant operation of the cleaner so that all sides will be presented to the blast. The machines are capable of taking anything that can be laid across the table and is not too high to pass under the sheet metal guard, which is placed about fifteen inches above the table. An apron of cloth or paper hung at the edge of the guard adjusts itself to the irregularities of the castings and prevents the sand from flying out.

A smooth, silvery matted surface is imparted to the casting by the complete removal of adhering and imbedded sand from the mold. Of course the scale can be completely removed if desired.

The sand used in the blast is exceedingly coarse. The force of the blast does not seem to be great, and there is no dust about the machine to cause discomfiture to the operator. It can be satisfactorily used in the open space of a foundry or cleaning room, which is not true of the high velocity sand blast nozzle tried and usually discarded for castings too large for a tumbling barrel.

Complete satisfaction with the machine was expressed in all the establishments where it was seen in operation.

Florence, Italy. FORREST R. JONES.

* * *

To anneal self-hardening steel so that it can be drilled and worked without much trouble J. W. Riley says: Heat the steel to a forging temperature, have some dry ashes laid on the floor and covered over with a layer of pine shavings. Lay the hot steel on the shavings, let it burn a little and then cover over with pine shavings and pack dry ashes over the top, making it air-tight. Let it remain until cold. To temper double gasket cutters heat the edges slowly to a tempering heat, not letting the body get very hot, and then cool in oil. The temper is then drawn to a dark straw.

MECHANICAL DRAWING.

AN EXTRACT FROM THE INSTRUCTION PAPERS OF THE AMERICAN SCHOOL OF CORRESPONDENCE.

In a course of mechanical drawing prepared by the American School of Correspondence, Chicago, Ill., Part VI is devoted to working drawings and was prepared by Chas. L. Griffin, Professor of Mechanical Engineering, Syracuse, (N. Y.) University. This pamphlet contains some of the most common-sense suggestions that we have seen, for the benefit of the student in drawing. It takes up the working drawings of a duplex direct-acting steam pump and follows them through from beginning to end. Mr. Griffin touches on one point in particular that should be impressed on the student in drawing, and that is, the method of blocking out or arranging the parts of a machine when designing; and he shows in a very clear manner what the essentials are in such work and how the sketches of a designer should appear when turned over to the detail draftsman. The accompanying illustration is one of several from this pamphlet and the quotations which follow indicate in a general way the direct and practical method adopted by the author.

The two chief requisites of a shop drawing, under which general heads a multitude of detail requirements can be summed up, are:

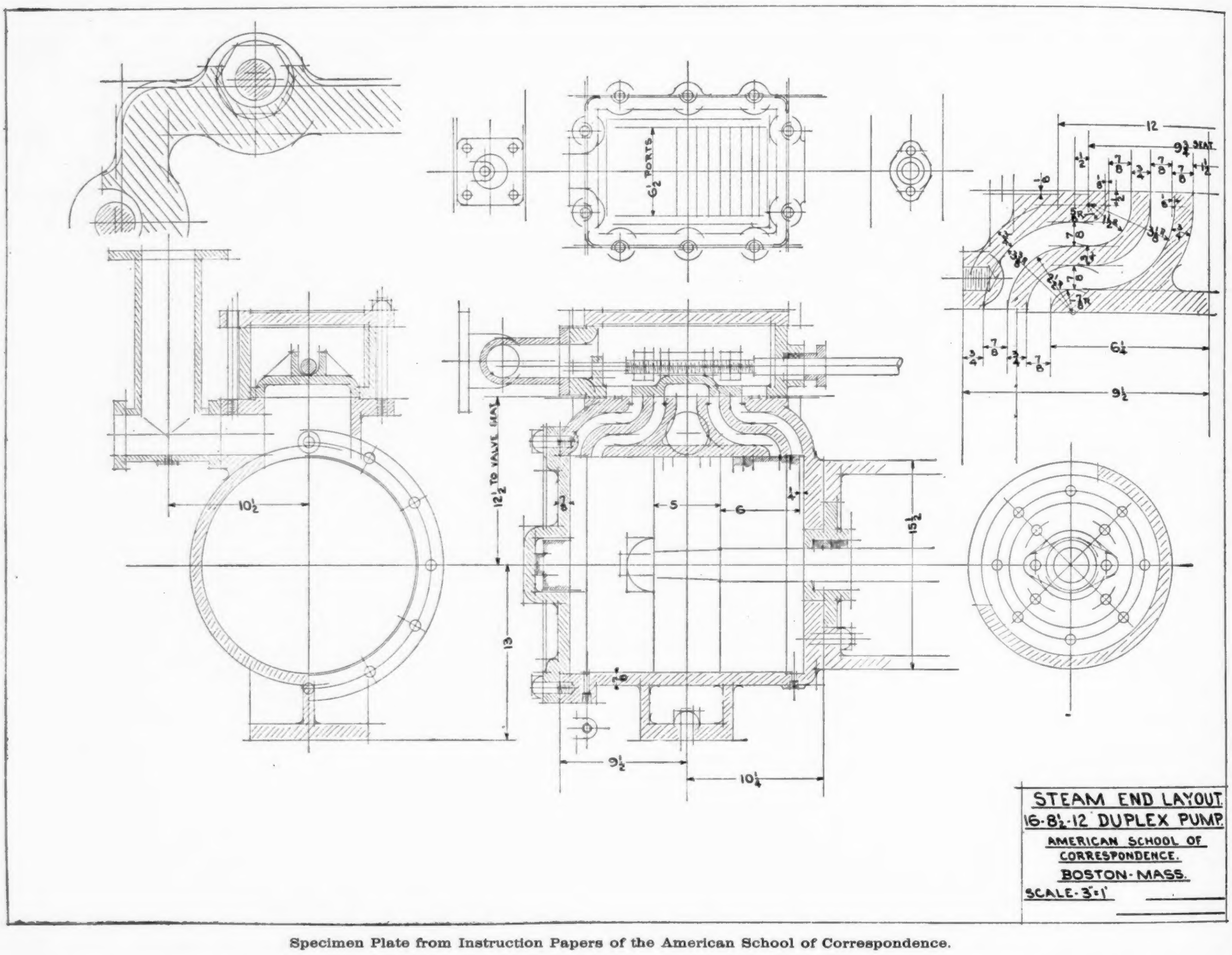
(1.) Absolutely complete and definite instructions from designer to workman.

(2.) Least possible cost in dollars and cents of production of the drawing measured by the draftsman's time.

It makes no difference how much we may attempt to disguise these two elements, the fact will still be apparent that "*complete instructions furnished for the least money*" is what the manufacturing shop is after, and what will be assumed as a basis for judgment as to the highest commercial utility.

As to the first point, that of completeness and definiteness of instruction, there must be no question of degree. If the information which the drawing furnishes is positive and complete, the drawing is good. If doubt arises in the workman's mind as to what the designer intended by a certain line or dimension, or if the dimension be omitted, the drawing is bad. There is no middle ground. The instructions are either present or absent, and the drawing good or bad accordingly.

The workman of to-day is not permitted to assume dimensions or shape. It is his business to execute the draftsman's orders; it is, however, often his privilege to choose his own way of doing it, but further than this modern practice does not allow him to go. He is held as rigidly to the orders specified by the drawing as the locomotive engineer is held to his bit of tissue telegraphic order to proceed, without which he dare not enter the next block. The drawing is supreme; it is official; it must be plain, direct and all-sufficient. It is the draftsman's business to make it thus, and he is not a draftsman until he does.



Specimen Plate from Instruction Papers of the American School of Correspondence.

This idea of positiveness must be thoroughly absorbed by the student. Positive action must be a habit which controls his every move, which marks every dimension he prints, which directs every line he draws. Every line must mean something, must have a definite reason for existence, must be necessary to illustrate the idea he wishes to convey to the workman; and every line must be a definite measurable distance from every other line, so that its location is fixed beyond a doubt. Lines which mean nothing, and cannot be measured, have no place on the drawing; they only confuse it.

Drafting-room labor is a relatively high-priced service, and the salary list easily assumes considerable proportions, so that wasteful excesses count up rapidly. One of the qualifications of proficiency invariably required for this department of shop organization is rapidity of execution. This is not dependent upon personal traits as at first might be supposed. A man may so husband his time and direct his efforts that he will easily distance his neighbor of more rapid motion. The latter may have less ability to make his energies count,

and lack of judgment as to when just enough, and no more than enough, energy has been expended on his drawings. From the standpoint of *utility*, the function of a drawing is fulfilled when it has reached the stage that it *completely* instructs; more time spent in elaboration is wasted, and is an unnecessary and therefore extravagant expenditure. The student must fully realize this. In his earnestness to produce finished and complete work he must constantly strive to accomplish results in the least possible time. This does not mean careless haste; far from it. A complete shop drawing cannot be made by short cuts, but through a systematic building of line on line, dimension on dimension. This is in sharp contrast to a haphazard habit of developing a drawing, first a line here and then a figure there, with no definite purpose in mind, and no hint as to when the drawing is actually completed.

The one method constitutes the efficient draftsman who works easily, receives a high salary, and is worth it, because he wastes no time in unnecessary labor. The other marks his unfortunate brother, plodding laboriously far behind, receiving a small pittance per hour, and worth less, because he does uncalled-for labor, and loses his definiteness of purpose in a maze of unexplainable lines and figures.

A working shop drawing, commercially considered, may well be defined as being "*Complete instruction from designer to workman issued at minimum expense.*"

The plate on previous page shows, as well as reproduction can accomplish, the pencil layout of the steam end of a direct acting steam pump. The layout is the first work of the designing draftsman. The drawing, as shown, is exactly the type of layout which he would turn over to a detail draftsman, whose duty would be to work up detail shop drawings therefrom.

The character of this drawing should be carefully studied. Remember that it is a layout, nothing more; also bear in mind that it is an exact, measurable working sketch. Attention is called to the sharpness of the lines, especially to the clean-cut intersections. Note the boldness, dash and businesslike style, the free-hand cross-section lines roughly put in. There is no hesitation or worry as to where the end of the line should be, or whether it crosses other lines which it theoretically should not. The intersections are allowed to indicate the termination of lines, and the rough section lines pick out the parts and separate them clearly to the eye. In this layout there is the spirit of confident, definite and rapid action, with no thought for absolute finish in line work, but with every thought for absolute results as to measurable dimensions.

There are two general rules of action in producing a drawing, which give the answer to the question that oftenest confronts the beginner: "What is to be done first?" or "What is to be done next?" These rules are:

1. Draw everything that is positively known.
2. Work from the inside to the outside.

Every problem has some positive data, assumed or calculated, to start with. The first thing to do in every case is to get this data represented by lines on the paper. An expert designer has been heard to say that until he had spoiled the blankness of his sheet of paper by some lines, he could not design. There is something in this; and almost invariably the first line to draw is a horizontal center line somewhere near the middle of the sheet; draw it! Draw it at once without hesitation, and the layout is begun. We now have something about which to build.

In this case the designer would first calculate the size of the piston rod, and determine the fastening to the piston. He would then draw the rod and build a hub around it. He would next calculate the width or thickness of piston and size of packing rings, and draw the two vertical lines 5 inches apart, to indicate the piston faces. These lines would be limited by the cylinder bore, which he knows to be 16 inches; hence horizontal lines 16 inches apart, parallel to and symmetrical with the center line, are the next to be drawn. Short vertical lines indicate the location of the packing rings. As the nominal travel of the piston is to be 12 inches, the location of the piston and rings can be shown on both sides of the central vertical line at the limits of travel. A clearance must exist between the heads and the piston (in this case ¼ inch is allowed), hence the lines of the heads can be drawn, and the general inside outline of the cylinder barrel is complete.

This is all in direct application of the foregoing rules, and is so simple, natural and direct that it hardly requires such explicit statement. We have simply taken such data as we had and put it on paper, placing it where it can be seen from all sides, and where the mind is relieved of the labor of carrying it.

If the student will only appreciate this one rule and draw all he knows about the problem, he is well on his way to its solution. *Draw everything you know, and work for what you don't know*, is what these rules say, and the first question to arise should be: "Have I drawn everything that is known about the problem?" before he asks himself or any one else: "What shall I do next?"

One other rule might be added to these two: *Keep dimensions in even figures, if possible.* This means that small fractions should be avoided. It is just as easy to bear this point in mind, and save the workman much annoyance and chance of error, as it is to disregard this matter. Even figures constitute one of the trade-marks of an expert draftsman. Of course a few small fractions, and sometimes decimals, will be necessary. Remember, however, that fractions must in every case be according to the common scale; that is, in sixteenths, thirty-seconds, sixty-fourths, etc., never in thirds, fifths, sevenths, or such as do not occur on the common machinists' scale.

* * *

THE NEW YORK 1902 MEETING OF THE A. S. M. E.

The American Society of Mechanical Engineers will hold their annual New York meeting at the Society House, No. 12 W. 31st Street, New York, beginning Tuesday, December 2, and ending Friday of that week. The titles of the papers to be read, are as follows:

Smoke Prevention by Mechanical Stoking. F. R. Hutton.

Volumetric Elasticity of Rubber. F. J. Miller.

Heat Resistance—The Reciprocal of Heat Conductivity. William Kent.

The Metric System. F. A. Halsey.

Final Report of Committee on Standard Methods of Testing Steam and Gas Engines.

A Rational Solution of the Measurements of Weights and Measures. Sydney A. Reeve.

Tests of a Twelve Horse Power Engine to Determine the Effects of Changes in Speed, Load, Point of Ignition, Ratio of Gas to Air, and Jacket Temperature. Prof. C. H. Robertson.

Deflection of Beams by Graphics. W. Trinks.

Entrophy Analysis of the Otto Cycle. S. A. Reeve.

Value of a Horse Power. A. F. Nagle.

Finer Screw Threads. Charles T. Porter.

Filing System for Office. Henry M. Lane.

Gift Propositions for Paying Workmen. Frank Richards.

Fly-Wheel Capacity for Engine-Driven Alternators. Walter I. Slichter.

A Forty-four Foot Pit Lathe. John M. Barnay.

Use of Surveying Instruments in Machine Shop Practice. C. C. Tyler.

Rotary Pumps. John T. Wilkin.

Continuous Record of the Position of an Engine Governor and the Speed of the Engine Which it is Governing. J. C. Riley.

Centrifugal Machines and Their Uses. Bartholomew Viola.

A New Oil-Testing Machine. Albert Kingsbury.

The officers named by the nominating committee to be voted for, are as follows:

For President—William Sellers, Philadelphia, Pa.

For Treasurer—F. H. Stillman, New York; F. H. Daniels, Worcester, Mass.

For Vice-Presidents—James Christie, Philadelphia, Pa.; John R. Freeman, Providence, R. I.; R. C. McKinney, New York.

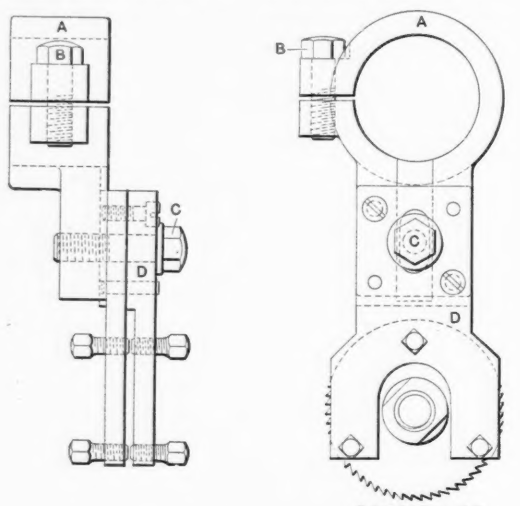
For Managers—S. S. Webber, Trenton, N. J.; Newell Sanders, Chattanooga, Tenn.

LETTERS UPON PRACTICAL SUBJECTS.

A GUIDE FOR DEEP SAWING.

Editor MACHINERY:

In cutting deep slots with a thin saw, it is common practice to overcome the tendency of the saw to run out of its course by reversing the usual direction of rotation and running it down onto and with the work. The table is either gibbed up more tightly than usual, or held back against the feed screw by a weight to take out the back lash, and prevent the work from running into the cutter. With unusually thin cutters, however, even these precautions fail to keep the saw from running out and breaking. The device described below was contrived by a milling machine operator who had much of this work to do, and it has proved to be very useful. *A* is a casting, bored out as shown to encircle the overhanging arm of the machine. It is split on one side, and furnished with a screw *B* to clamp it in position. To the lower end of this casting is adjustably fastened, through screw *C* and the tongue shown, the holder *D* made of two pieces of steel screwed and doweled together. This holder is brought down over the saw and arbor as close to the work as possible, and carries six snugly fitting brass screws, arranged as shown in the drawing. The flat ends of these screws are adjusted so that they just touch the saw on each side, and thus confine it closely to its proper path. It has been found that this arrangement, when carefully used, will greatly reduce the breakage of the saws in deep cutting.



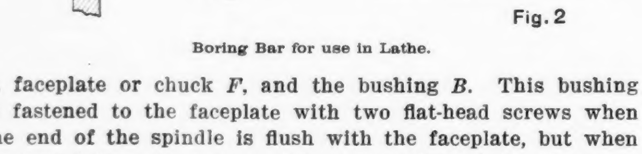
Guide for Thin Milling Saw.

R. E. F.

A CONVENIENT BORING BAR.

Editor MACHINERY:

The boring bar shown in the accompanying sketch is for use with a hollow spindle lathe for boring long holes in chucked work where the spring of the common boring bar gives trouble. Fig. 1 shows the bar *H*, a section of the lathe spindle *S*, faceplate or chuck *F*, and the bushing *B*. This bushing is fastened to the faceplate with two flat-head screws when the end of the spindle is flush with the faceplate, but when the faceplate projects beyond the end of the spindle, the bushing is made flush with the faceplate and a screw is put in the joint between the two, half of its thread being in each piece.



Boring Bar for use in Lathe.

The cutting tool *T* is made of round stock and is set by an adjusting screw *C*, at the back side of the bar, and is fastened in position by means of the setscrew *E*. The clamping block *F* is shown in Fig. 2, in position on the cross slide of the lathe, *D*. When the nut is screwed down on the bolt *A*, it clamps both the bar and the block firmly to the cross slide.

In making the clamping block the hole for the bar should be bored with a common boring bar, between the lathe centers, with the block clamped in position on the cross slide by the bolt *A;* this insures the hole being bored the correct height (it beirg assumed that the cross slide has no tilting device.) After the block has been bored a close fit for the bar, the slot is cut. The block should be bored for the largest size of bar that will be used and bushings made for the smaller bars. The end of the bar entering the hollow spindle is made smaller than the remaining portion, to allow it to be used in small holes and still keep the greater portion heavy and strong; but if desired, a straight bar could be used which would be somewhat cheaper to make.

A tight-fitting leather washer slipped on the end of the bar before it enters the bushing *B* will keep dirt out of this bearing and prevent undue wear.

When setting the bar, the tail-stock should be straight with the ways of the lathe and the cross-slide so set that the center of the bar will come on the tail-stock center.

It is always advisable to place the clamping block as near the cutting tool as the length of the hole to be bored will allow.

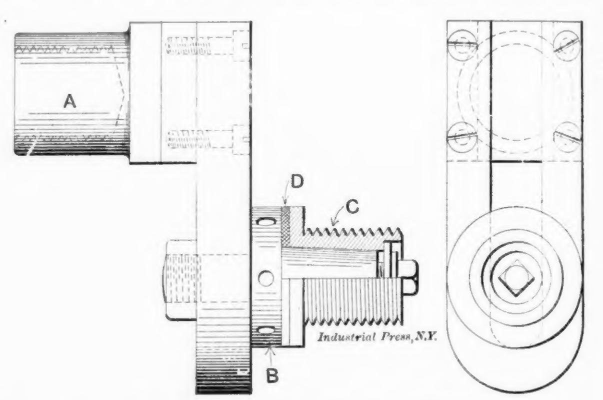
M. H. BALL.

Watervliet, N. Y.

ECCENTRIC BORING ATTACHMENT.

Editor MACHINERY:

A large number of small shops are not equipped with a lathe chuck in which articles can easily be chucked eccentrically so as to turn the article "off center." Even in shops that are equipped with combination universal and independent chucks it is always more or less trouble to chuck a piece in this manner, especially when a great amount of eccentricity is required or where the castings are of peculiar shape. In a great many cases it will be found very difficult to chuck certain pieces just where they are wanted even with the best chuck on the market.



Lathe Attachment for Eccentric Boring

The sketch illustrates a very simple attachment that can be fitted to the spindle of a lathe, to be used with any kind of a chuck, for obtaining any amount of eccentricity that is within the range of the swing of the lathe.

This attachment may be made in one piece of cast-iron or it may be made of machinery steel, with the parts fitted together as shown in the sketch. When made in the latter way it is, of course, much more substantial than when made of cast-iron. The stock *A* is bored out and threaded to fit the spindle of the lathe on which it is to be used. In the yoke slides a T-bolt *B*, which can be moved to any distance off center that is within the limits of the yoke. On this T-bolt is the sleeve *C*, which is turned and threaded to the same size as the nose of the lathe spindle and is so arranged that it can be turned on the bolt, or by removing the back washer *D*, it can be clamped solidly to the bolt. If it is desired to bore a hole in a disk, two inches off center, all that is necessary is to set this T-bolt two inches from the center of the lathe

spindle, clamp the sleeve solidly to the bolt and then screw on the chuck in which the disk has been chucked centrally. If it is necessary to bore a number of holes in the disk, each two inches from the center, all that is needed is to loosen the sleeve after each hole has been drilled and allow the chuck to revolve about the bolt *B* until each successive hole is brought in line with the center of the spindle.

This attachment can be adapted to a great variety of work and by graduating the yoke it can be very quickly set to any desired distance off center. If it is intended to use it on a high-speed lathe it will be necessary to extend the yoke on both sides of the center in order that a counterbalance may be attached to the outer end to balance the weight of the chuck.

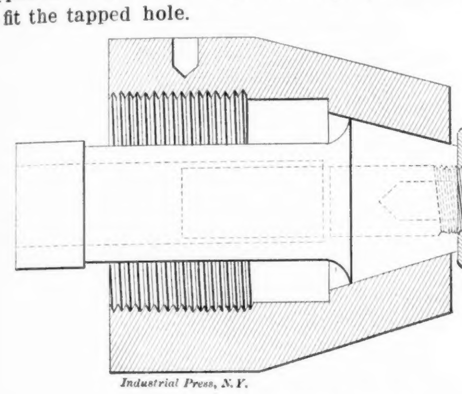
Burlingame, Kansas. CHAS. G. TAYLOR.

A SCREW MACHINE CHUCK.

Editor MACHINERY:

In the October issue of MACHINERY appeared an article under the heading: "A Screw Machine Chuck." I think the chuck is very expensive for the work done, and I send a sketch of a simple device that I have used for years, with good results, on the same class of work on a wire feed screw machine.

It consists of a plain piece the same size as the thread tapped in the piece to be operated upon, with one end threaded to fit the tapped hole.



Chuck for use on Screw Machine.

The method of operating is to tighten the arbor in the chuck, screw on the piece, perform the operation; then to loosen the piece, open and close the wire feed chuck quickly which pushes the arbor out just enough to loosen the piece so that it can be easily unscrewed with the fingers.

Denver, Col. J. F. SHAY.

MORE COUNTERBORES.

Editor MACHINERY:

We recently made a tool for counterboring the holes shown in Fig. 1, and at the same time rounding the corners at *A*. The tool we first tried is shown in Fig. 2. It was simply a piece of 1 7-16 cold-rolled steel shafting with a 5-16 square tool held in by a setscrew. With the cutter properly ground and set it worked quite satisfactorily but as the cutter had to be removed for grinding and did not retain its form, it was somewhat difficult to keep it doing the work uniformly. So, an improvement being in order, we made the counterbore shown in Fig. 3, which is the tool now in use. There are two cutting edges and it is made to retain its proper form until comparatively worn out. The shank is tool steel, as well as the cutter, and the teat is hardened, having been ground to size after hardening.

Tools of this kind are quite readily made in the lathe. For this one a lathe was used with a four-pitch leadscrew and geared to cut one thread per inch. The cutter blank being turned it was put on an arbor in the centers and lines were scribed on the outside parallel to the axis and diametrically opposite, to indicate the location of the cutting teeth, and with the point of a thread tool a helical line was started from each parallel line and drawn half way around the blank. Then the gap in front of each tooth was cut in the shaper (on a radius) and the helix roughed out. The finishing was comparatively easy, the tool did not have to be withdrawn and the power crossfeed was used. A cut was started from the outside at one of the cutting edges and fed toward the center; when the opposite gap reached the tool the leadscrew nut was disengaged and the carriage moved back two threads on the leadscrew. The cut was then continued as before. The lathe was run by power part of each half revolution.

It will be seen that matters were much facilitated by the even pitch of leadscrew and by lathe being geared to 1 inch of carriage travel per revolution of spindle. With an uneven pitch of thread on the leadscrew it would have been necessary to withdraw the tool at each gap and it would have been

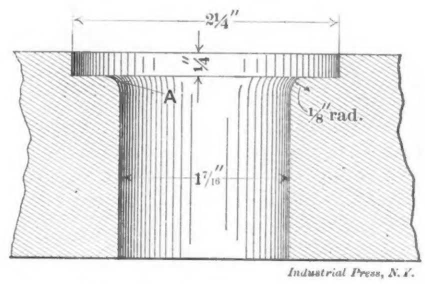


Fig. 1. Hole to be Counterbored.

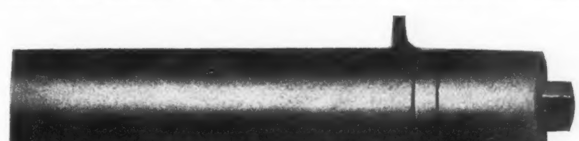
more difficult to get the cutting edges on a line at right angles to the axis. The same trouble would have been experienced if the lathe had been geared to a fraction of an inch. It may not always be possible to gear the lathe to a pitch so well suited to easy manipulation as we did with this tool, but in this case it produced a nice angle of clearance. Taking the largest diameter, 2¼ inches, the circumference is 7.07 inches and with one inch advance per revolution the clearance is about 8 degrees, increasing toward the center.

Grand Rapids, Mich. CORNEIL RIDDERHOF.

MARKING DRILLS AND TAPS.

Editor MACHINERY:

With all the progress that has been made within the last 20 years in small tools such as drills, taps and reamers, one thing has been lost sight of and that is the proper stamping of the same. As long as these were only hand tools the stamping as of old was all right, but this is no longer the case. But few shops have separate taps for hand and machine use, and when the hand tap is put into a chuck it is only a short time before the shank is so badly mutilated that the stamping is beyond recognition. For this reason the custom of marking



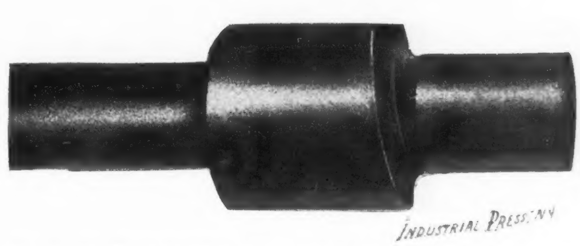


Fig. 2. The First Counterbore. Fig. 3. The Present Counterbore.

the size on the shank, just below the square, is entirely out of place. Some manufacturers have adopted the plan of stamping reamers between the flutes and the shank, which is the only correct way.

For marking taps, as most of the taps of the present day are made with concave flutes, I see no reason why they cannot be stamped there, if the marking wheel or stamp is made to conform to the shape of the flutes. This would however be practical only in sizes above, say, 3-16 inch. I do not think that the stamping in the flutes will influence the pitch or make the tap warp enough to cause any trouble.

The troubles with taps and reamers, however, are nothing compared with those which arise from the improper marking of the twist drill. The number of sizes is so unlimited and the difference in sizes so slight that accurate marking is an absolute necessity. If one looks over a lot of twist drills that have been in use for some time he will find that some of them are worn a full thirty-second of an inch below size and any marks that may have been on the shank have long since been obliterated.

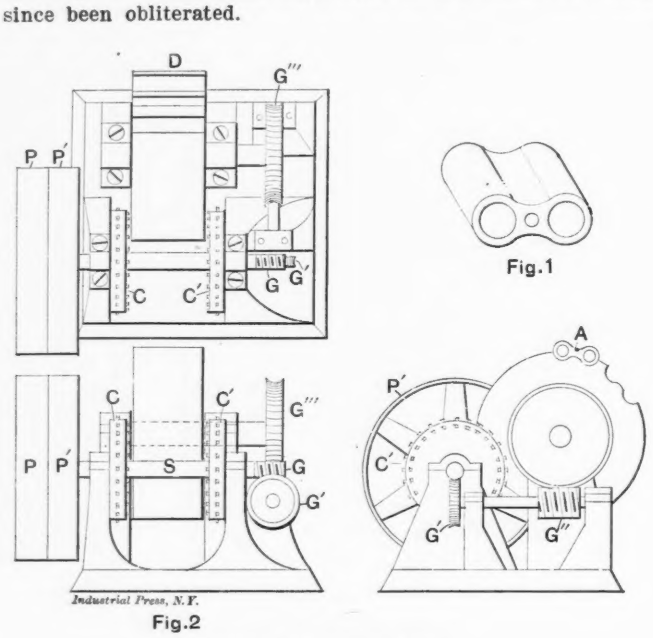


Fig.2

Machine for Continuous Milling.

In a tool room where hundreds of drills are exchanged every day the time lost in looking up the sizes is by no means a small matter, not taking into consideration the amount of work that is spoiled, due to mistakes arising from lack of proper markings.

Now, as a remedy for these troubles, I would suggest that a flat be milled at the upper end of one of the flutes and the drills marked on this flat. This need not be very large, for small figures that will stay are much better than the present large figures that are worn off after the drill has been used a few times. The milling need not be very deep, as that part of the drill nearest to the flute is worn the least.

Another way would be to turn a small groove around the shank near the flutes, but this would have the objection of weakening the drill and would not be practical with the smaller sizes.

I would like to hear from some of the readers of MACHINERY on this subject, in hopes that a better method might be adopted for marking this much abused tool. Even if the stamping added a slight increase to the cost, the benefit derived would certainly warrant it. CHAS P. THIEL.

Lawrence, Mass.

A CONTINUOUS MILLING MACHINE.

Editor MACHINERY:

In Fig. 1 is shown a piece of work, a large number of which were to be finished on each end, all to be of the same length. This was accomplished in the continuous milling machine shown in Fig. 2. On the shaft *S*, bearing the tight and loose pulleys *P* and *P'*, is mounted a pair of inserted tooth milling cutters, *C*, *C'*, which are set the proper distance apart to enable them to face both ends of the work to the required length. On the outboard end of this shaft is worm *G* driving the wormwheel *G'*. This in turn drives the second worm *G''* and the wormwheel *G'''*, which is on the end of the shaft carrying the drum *D*. The periphery of this drum is shaped to form a series of seats suitable for holding the work. Only two of these seats are shown in the sketch, but on the machine they are continued around the entire circumference. A piece of work is fastened into each of these pockets, as at *A*, and is slowly fed between the milling cutters by the revolving drum. As each finished piece comes out from the cutters it is removed and an unfinished piece put in its place without stopping the machine. The surface of the drum is thus kept continually covered with work and the operation is continuous.

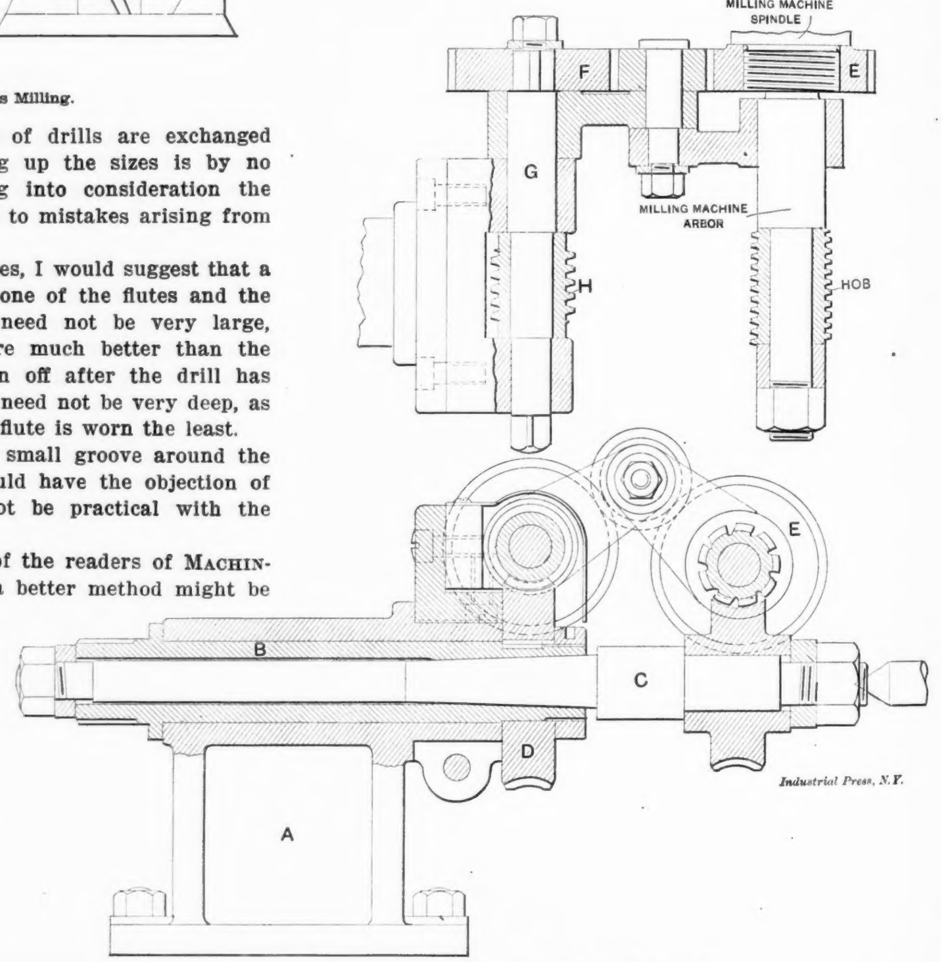
Connersville, Ind. E. M. BURGESS.

A HOBBING ATTACHMENT FOR THE MILLING MACHINE.

Editor MACHINERY:

In our line of work we have to make quite a number of wormwheels and until recently they were cut by first being nicked with a gear cutter and then finished with a hob, the hob rotating the wheel as it was cut. This was a very slow job so I made the device shown in the sketch which did away with the nicking and indexing. We had a headstock like *A*, which was used for circular milling; from this I removed the spindle *B* and bored out the rear end of it to suit a standard taper. I then made an arbor, *C*, on which was placed the wormwheel to be hobbed. The gear *E* fitted on the nose of the milling machine spindle and had the same number of teeth as the wormwheel *D*; and the gear *F*, on the shaft *G*, had the same number of teeth as the worm gear to be hobbed. This arrangement feeds the blank around at exactly the same rate that it would be fed by the hob and at the same time relieves the hob from all work other than the actual cutting of the teeth. Worm gears of any number of teeth can be cut by changing the gear *F* to one having the same number of teeth as is desired for the worm gear. Both hob and worm *H* have single right-hand threads, so for hobbing left-hand worm gears two intermediate gears are placed between gears *E* and *F*. For cutting gears of coarse pitch the foot stock center is used to support the arbor *C*. With this device we are able to finish worm gears in about one-quarter of our former time.

Hamilton, Ohio. HERMAN ISLER.



Milling Machine Attachment for Hobbing Worm Wheels.

COMPOUND INDEXING.

Editor MACHINERY:

Having charge of the milling machines in a shop where a great variety of gears had to be cut on machines having but one index plate, it so happened that we had to send many of the blanks to be cut outside or spend a great deal of time figuring out the movements for compound indexing. I therefore made out a list of the gears that could not be cut with any single circle but which we could cut by compound indexing with two circles. I found 65 of these, as will be seen by referring to the accompanying table. This table is made out for use with the index plate of a Cincinnati milling machine, but is, of course, applicable to any index head in which the ratio of the worm to the worm gear is 1 to 40.

In order to use the compound indexing method it was only necessary to make a small index pin, mounted in a slotted brass casting, which was bolted on one of the screws used for clamping the dividing head. The side locking device having been removed, the index pin in the back holds the plate rigid while the forward movements are being made.

In referring to the table, the plus sign (+) indicates that the movements should be in the same direction, to the right; the minus sign (—) indicates that the first movement, at the left of the sign, should be made to the right, while the second movement, at the right of the sign, should be made to the left.

TABLE FOR COMPOUND INDEXING ON CINCINNATI MILLING MACHINE.

No. of Divisions.	Circle.	Holes.	Circle.	No. of Divisions.	Circle.	Holes.	Circle.	No. of Divisions	Circle.	Holes.	Circle.
51	42	28 + 4	34	154	66	3 + 6	28	258	30	20 — 22	43
57	66	22 + 14	38	161	46	18 — 4	28	259	37	11 — 7	49
63	18	2 + 22	42	171	38	11 — 3	54	266	38	3 — 3	42
69	24	16 — 4	46	174	18	6 — 6	58	273	49	21 — 11	39
77	28	12 + 6	66	182	39	3 + 6	42	276	18	12 — 24	46
87	58	46 — 6	18	186	18	3 + 3	62	279	18	11 — 29	62
91	39	6 + 12	42	187	34	15 — 15	66	282	47	38 — 12	18
93	24	8 + 6	62	189	28	8 — 4	54	286	39	9 — 6	66
99	66	34 — 2	18	198	18	2 + 6	66	287	41	35 — 35	49
102	42	14 + 2	34	203	28	6 — 1	58	288	38	16 — 16	58
111	66	22 + 1	37	204	34	1 + 11	66	294	49	23 — 6	18
114	42	28 — 12	38	207	18	7 — 9	46	301	43	18 — 8	28
117	39	9 + 6	54	209	38	9 — 3	66	306	54	15 — 5	34
119	42	24 — 8	34	217	28	2 + 7	62	308	66	18 — 4	28
123	41	27 — 22	66	222	37	19 — 18	54	329	47	46 — 24	28
126	42	4 + 4	18	228	38	13 — 9	54	333	54	24 — 12	37
129	18	6 — 1	43	231	28	4 + 2	66	336	42	12 — 4	24
133	38	6 + 7	49	234	54	12 — 2	39	342	54	12 — 4	38
138	18	6 — 2	46	238	34	30 — 35	49	345	46	13 — 5	30
141	47	29 — 6	18	246	41	34 — 36	54	348	58	26 — 6	18
147	39	13 — 3	49	252	18	2 + 2	42	351	54	2 + 3	39
153	54	3 + 7	34					357	42	1 + 3	34

For example: To secure 51 divisions, we first move 28 holes on the 42 circle and 4 holes on the 34 circle, both movements being made to the right. This gives us

$$\frac{28}{42} + \frac{4}{34} = \frac{1120}{1428}$$

of one revolution of the worm and, since the ratio of the worm to the worm wheel is 1 to 40, we have

$$\frac{1}{40} \times \frac{1120}{1428} = \frac{1}{51}$$

of a revolution of the spindle.

For an example of the second case: Suppose that we wish to obtain 69 divisions, we would first move to the right 16 holes on the 24 circle and then to the left 4 holes on the 46 circle. This gives us $\frac{16}{24} - \frac{4}{46} \times \frac{1}{40} = \frac{1}{69}$ of a revolution of the spindle.

In executing movements to the left, pass the required hole then turn to the right to the proper hole. This avoids errors caused by back-lash in the worm gear.

Chicago, Ill. ROBERT A. LACHMANN.

SENSITIVE ATTACHMENT FOR MEASURING INSTRUMENTS.

Editor MACHINERY:

I have often wondered why the system of sensitive measurement such as is found on a Bath indicator is not more extensively used. No matter how finely and accurately micrometers and verniers may be made, dependence must in all cases be placed on the sensitiveness of a man's hand to obtain the exact dimensions of the piece to be measured. In order to overcome this difficulty and eliminate the personal equation in the manufacture of duplicate and interchangeable parts, I have tried the sensitive attachment to the micrometer shown in Fig. 1 and found it of much value.

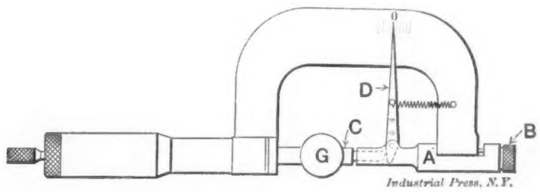


Fig. 1. Sensitive Attachment applied to the Micrometer.

The auxiliary barrel *A* is held to the anvil of the micrometer by means of a thumb screw *B*. In the inside end of the barrel is a secondary anvil *C*, the base of which bears against the short arm of the indicating lever *D*. The action will be clearly seen by reference to the cut. The micrometer is so set that when a gage, *G*, of exact size is placed between the measuring points the long arm of the indicator stands at the 0 mark. If the pieces being calipered vary in the least from the standard size it will be readily noted by the movement of the pointer. Hard rubber spheres turned from rough casting were found to vary from 3 to 5 thousandths after having passed the inspector's test with an ordinary micrometer. With this attachment the inspector's helper could detect very minute variations from the limit size. The same device was used to gage the size of small brass disks about half the diameter of the rubber spheres, and in fact anything within the limits of the micrometer can be made to show to the naked eye variations as small as a ten thousandth.

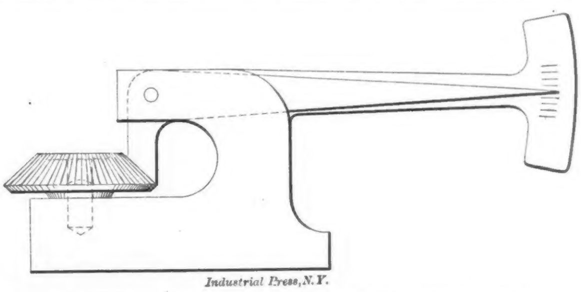


Fig. 2. Sensitive Attachment applied to Gaging Bevel Gear Blanks.

Considerable trouble was experienced with a pair of small brass miters because of the difficulty of getting the outside diameter just right. Inasmuch as they were finished on a screw machine some of the holes were not concentric with the face, causing the gears to bind. Fig. 2 shows a gage which was quite inexpensive and at the same time showed up the slightest inaccuracy. I have given only two ways

in which this sensitive idea may be applied and I am sure that a wider field of application will suggest itself as its merits become more appreciated. H. J. BACHMANN.

New York, N. Y.

VALVE AND PISTON MOVEMENTS.

Editor MACHINERY:

The following article contains some rather peculiar and interesting facts regarding the valve and piston movements of a compound pumping engine, where the center of the flywheel is considerably above the center line of the crosshead.

The pump, as originally constructed, had a 32-inch steam and a 26-inch water cylinder with a 48-inch stroke, and made 23 double strokes per minute. It was equipped with steam operated piston valves. There were two pumps of this size and style placed side by side. These pumps were straight line, direct acting and did not have any flywheel, therefore, of course, the steam was not used expansively. The indicator card showed almost the same pressure when exhausting, as the initial pressure of the steam entering the cylinder. The pumps were supplied with high-pressure steam which had to be wire-drawn at the throttle to prevent too high speed. It can easily be seen from the foregoing statements that the pumps were not of the most efficient type. It was proposed, therefore, that the pumps be tandem compounded, duplexed, and a flywheel added—which was eventually done—and just here considerable trouble was experienced due to lack of room. The pumps were placed very close together and could not be moved. The diameter of the flywheel was limited by lack of head room and various other parts of the construction were also affected by lack of room, as will be seen later. After compounding, the steam cylinders were 22 inches and 40 inches in diameter. The stroke and the water cylinder were left the same as before. There were two flywheels each 12 feet in diameter but these two were not large enough for a very short cut off, but still answered the purpose very well.

Now, with these few words of explanation regarding the conditions which limited our construction I will proceed with the conditions which we found; presenting a couple of sketches to make clear the explanation. While the conditions here presented are not new, still I know of no other case of an engine in which the conditions are so exaggerated. Of course the case is frequently met, in the Westinghouse engines for instance, where the centers of flywheel and cross-

Fig. 1. First Arrangement.

head are not in line, but seldom to such an extent as here. Shaper heads are usually designed with a quick return, on the same principle, but there, there is no valve to contend with.

As will be seen from the accompanying sketches, the travel of the crosshead is 48 inches, but the diameter of the crank-pin circle is only 46⅞ inches. The length of connecting rod is 9 feet 5¾ inches, or a ratio of about 2½ to 1. The stroke of the valve, which was of the piston type, was 4½ inches.

Fig. 1 shows drawing as originally laid out and as the first model was made.

Fig. 2 shows the arrangement finally adopted.

Now starting the crosshead at *a*, which is the first dead center (and rotating crank pin in direction of arrow) when the crosshead reaches *b*, which is the first half of the out stroke, the crank pin will be at *b'*, or will have traversed an arc of nearly 33¾ inches. While the crosshead travels the second half of the out stroke from *b* to *c*, the crank pin traverses an arc from *b'* to *c'*, or nearly 37⅞ inches. During the first half of the in stroke the crosshead travels from *c* to *b* while the crank pin travels from *c'* to *b''* or an arc of nearly 40⅜ inches. While during the last half of the in stroke the crosshead travels from *b* to *a* while the crankpin travels from *b''* to *a'* or an arc of nearly 35⅜ inches. Now from these figures it can be seen that, with the fly wheel circumferential speed, or crank pin speed, remaining constant, the piston speed must vary considerably for each quarter and also for each half of the full double stroke. In fact the actual mean piston speed for each quarter of the stroke is as follows:

1st quarter from *a'* to *b'* is 192.1 feet per minute.
2nd quarter from *b'* to *c'* is 171.2 feet per minute.
3rd quarter from *c'* to *b''* is 160.6 feet per minute.
4th quarter from *b''* to *a'* is 183.3 feet per minute.

Thus the first quarter of the stroke is nearly 20 per cent. faster than the third quarter.

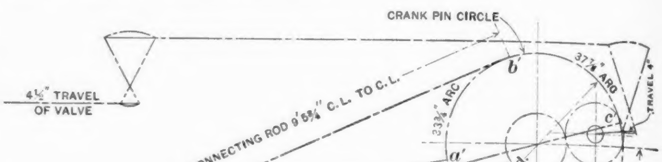


Fig. 2. Final Arrangement.

The eccentric which operated the valve could not be placed on the main shaft on account of the large diameter of the shaft and the lack of clearance room, so a gear was put on instead and this meshed with a similar gear on the eccentric shaft. The eccentric strap connected with a lever, which in turn operated a link, a lever, and another link until the valve was finally reached.

Now while the piston speed varied considerably, the valve speed was uniform because operated by the circumferential speed. Of course under these conditions no satisfactory kind of indicator card could be obtained, for when the lead and compression of both ends were equal there was 7 15-16 inches difference in the cut-offs, and the results were *vice versa* when the lengths of cut-off were equal.

To overcome this difficulty two methods were suggested, one, of making the angle between the eccentric strap center line and a horizontal line equal to the angle between the connecting rod center line and a horizontal line; also of making the ratio of the length of eccentric strap to the throw of the eccentric equal to the ratio of the length of connecting rod to the diameter of crank pin travel. By this method it was intended to make the speed of the valve directly proportional to the speed of the piston at all points.

The other method was to make cam gears to operate the eccentric. These cams were to be so shaped that the same result would be obtained.

The former method was chosen as being the more practicable and more likely to give satisfactory results.

A drawing was made and from the drawing a model, which made the piston and valve speed proportional at all points of the stroke, using the proportions explained above, when piston and valve started together from dead center; but when the advance was given to the valve, the first, or fastest, quarter travel of the valve was thrown so far ahead of the piston that the results were still poor. After changing the angle a few times, by trial, between the center line of eccentric strap and a horizontal line, the desired result was obtained as shown in Fig. 2.

These two pumps were duplexed and connected at an angle of 90 degrees, which produces the following conditions. When the crosshead of No. 1 pump is at *a* the crosshead of No. 2 pump is beyond *b* because the crank pin has an advance of 90 degrees or has traveled an arc of about 36 13-16 inches. When the crosshead of No. 1 pump has reached *b* the crosshead of No. 2 pump is not quite to *c*, because the second arc

from b' to c' is more than 36 13-16 inches. During the third quarter of the revolution the piston of No. 1 pump still further gains on No. 2, but in the fourth quarter the reverse condition holds. This then presents a condition in which there is a never-ending alternate increase and decrease of distance between the two pistons, or for one-half the revolution there is less than a half stroke between the pistons and for the other half of the revolution there is more than a half stroke between them.

This, however, does not materially affect the efficient running of the pump. H. H. D.

DIES USING RUBBER AS AN AGENT FOR FORMING DIFFICULT SHAPES.

Editor MACHINERY:

The piece which is made by the dies herein described is used as a screw cap for cans, bottles, etc., and is a typical illustration of the class of work for which these dies are fitted.

Different manufacturers of such goods have different methods for rapidly producing formed blanks of this character. In some factories wax is used as an agent for forming blanks by first filling the cup-shaped blank with melted wax, and then placing under pressure. But the use of wax necessitates melting, after blank has been formed in order that the wax may be removed. Another method is to draw the blank to a cup shape and then roll the thread on, which is a very economical way where there is no bead on top of the blank.

The dies described in this article were constructed to use rubber for forming the blank and proved to be very satisfactory.

The first step in the production of the screw cap is to determine the proper diameter to make the blanking punch and die. If a formed blank is furnished as a model, then the die maker may determine the proper diameter of blanking die, by scribing a circle with a pair of dividers on a piece of sheet metal the exact thickness and of same material as the model. The circular piece is then cut out, and by carefully reducing diameter until it balances exactly with model, he may then proceed to make blanking die of same diameter as the round piece cut from the sheet metal. It is necessary that the balance scales used be very accurate.

When a bottle or can is furnished as model, then the die maker must depend largely upon former experience and also the familiar method of "cut and try." For cheaply producing any style of drawn work, a double-action press is used when possible. The shaft of such a press has two cranks or eccentrics so arranged that as the blanking punch starts on the upward stroke, after punching out a blank, the drawing punch descends through center of blanking punch and forces blank through the drawing die, which is in the center of the blanking die. This arrangement will be clearly understood by referring to Fig. 2. The edges of drawing die are well rounded, and the end of drawing punch is made on the same radius as the top of the model, and same diameter as the inside. The blank, of course, takes same shape as drawing punch, thereby lessening the amount of work for the rubber to perform.

In "setting up" a drawing die, the essential point lies in having the blanking punch "iron the blank." In other words the press is so adjusted that blanking punch presses the blank firmly at bottom of die at S, Fig. 2; otherwise the blanks will not draw evenly, or be of a uniform height. The stock is well oiled with a lubricant consisting of ¾ parts of pure lard oil and ¼ of soft soap thoroughly mixed. The blanks as they appear after passing through drawing die are shown at A, Fig. 1. They are then placed on a revolving lathe spindle that has been turned to exactly fit them on the inside. The tail spindle is turned to conform with outside end and is so constructed that when brought to bear on blank by means of a lever, the friction causes the tail spindle to revolve. The lever end of tail spindle has a ball or knob turned thereon, that runs in a ball bearing seat to reduce friction. An ordinary knurl, straight across the face, is then brought to bear upon the blanks, and it is knurled as shown at B, Fig. 1.

The first thing to be considered in constructing the forming die is the selection of a rigid, powerful press as it requires quite a little power to force metal. Having decided upon the press, a cast iron bolster, B, is made. This is shown, with the dies in place, in Fig. 4. It should have all bearing surface possible upon the bed of press, and be as thick as stroke of press and length of punch will allow. It is planed on the bottom and the dovetail on top in which the dies slide, great care being exercised to have the angular sides parallel. A hole is drilled at C for the adjusting screw and holes are drilled and tapped for the set screws AA to fasten securely one half of die and to adjust the gib for the other half. The next step is making the dies. They are made in halves as

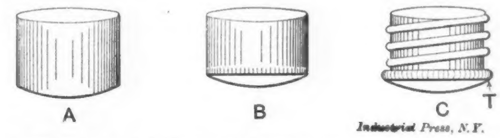


Fig. 1. A, The Blank. B, The Blank after Knurling. C, The Completed Cap.

shown in Fig. 3. The steel is selected of a high grade and properly annealed. They are then planed all over to within 1-32 inch of finish size and annealed again. Annealing after scale has been removed is to remove, as far as possible, the strain that must be in the steel, and the probability of their changing during hardening, is much lessened. The dies are then planed to required size, and beveled to fit the bolster, allowance being made for the gib. One half of the die is drilled and counterbored at C, for the lever hinge which is shown in place in Fig. 4. A holder or sub-bolster is then made to hold dies securely while they are being turned in the lathe. The dies are then placed in this holder and fastened by means of set screws.

The line where two halves meet is carefully prick punched in center of dies. The proper pitch of model is then ascertained by dividing 1 inch by the distance from center of one thread to the center of next. A templet is filed to the shape of thread and an inside thread tool made to match the templet.

The holder, or sub-bolster, is fastened to faceplate, the dies "wriggled up" by prick punch mark, and a hole bored the same diameter as inside of blank, ¾ inch deeper than length of model. The bottom of hole is turned the same radius as the model. Then, starting ¾ inch below surface of die, the hole is enlarged to diameter of outside of blank B, Fig. 2. The lathe is then geared to cut proper pitch, the thread is chased and the recess is bored for the bead T, Fig. 1. By leaving the hole at top of die the same diameter as inside of blank, the edges of the blank are prevented from cutting the rubber, besides allowing a tight fit for the punch, thereby positively confining the rubber.

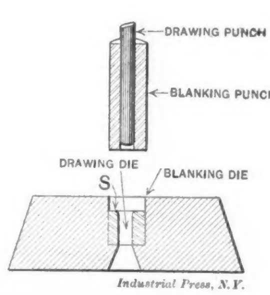


Fig. 2. Section through Double Action Press.

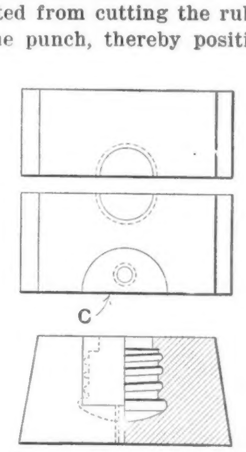


Fig. 3. The Die used in Forming the Cap.

The impression in the die is well polished, as the tool marks will show on blank if they are left as turned. The bolster or holder is then removed from lathe and without disturbing the dies, the impression is poured full of babbitt, after having been first treated with a light coating of graphite to prevent the babbitt from sticking. When thoroughly cool the dies are removed from the holder and the babbitt taken from impression and laid aside for the time being. A piece of rubber such as is used for wagon springs is turned or shaped to fit inside of the blank, sufficiently free to allow it to be easily inserted and removed and of a length that reaches nearly to top surface of dies when it is placed in the blank in the die.

Before hardening, the dies are placed in the bolster, the half P, Fig. 4, is fastened securely by means of the set screws and the half R is adjusted by means of gib and set screws so that it slides freely when moved by the lever.

The dies are then closed and the lever hinge I adjusted so that when the dies are together, the two parts of the joint G will be in a straight line, thus preventing the dies from opening when under pressure. This adjustment is accomplished by the screw E which is retained in its position by the check nuts, $F\,F$. The dies are then ready to be aligned with the punch.

In aligning the die and punch, the ram of press which holds the punch is lowered until punch nearly touches the die. The bolster is then raised by placing a substantial stick of wood up through bed of press, and lifting bolster with knee, using both hands to guide it. When the punch enters the die, the ram is lowered until bolster rests on bed of press, in which position it is firmly fastened. By pulling over the lever the dies are opened. A knurled blank, containing the piece of rubber, is now inserted and the dies closed. The rubber does not compress, when under pressure, so when the punch descends upon it the metal is forced out where not supported by the dies. When the punch ascends, the rubber returns to its original shape and is easily removed from the finished blank.

One or two blanks are formed while the dies are soft, to prove that they are correct, after which they are hardened.

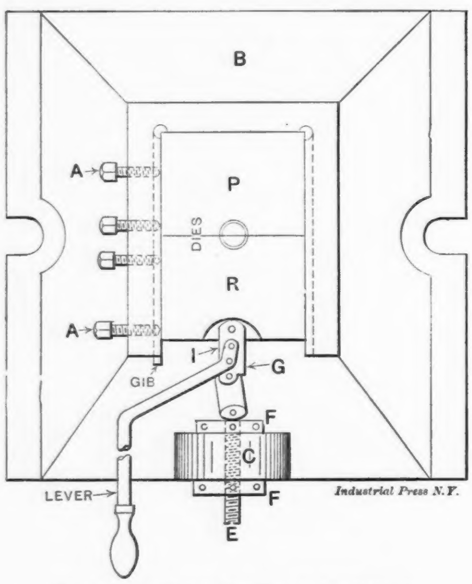


Fig. 4. The Dies in Position in the Bolster.

To get best results they are packed in a crucible, using ground bone to exclude air and insure an even heat. The degree to which they are heated will depend upon the quality of the steel, and the die maker must, therefore, be familiar with the grade of steel used. When the proper heat has been attained, the dies are immersed one at a time in a bath of clear water previously warmed. They should be held in one place, as the swashing back and forth tends to cause them to warp. As soon as the hand can be borne against the dies in the bath, they are removed, polished with emery cloth and placed at one side of fire on hot ashes until the proper color denoting temper appears. It is customary with a great many tool makers to constantly wipe the face of the die with oily waste while drawing temper. But it is not good practice, as the oil burns on die, and produces a deep straw color; and when die is cool, that same color can easily be wiped off. Therefore it is better not to put anything on die that is liable to produce a false temper. After hardening, the dies are soldered together, using the babbitt mold to keep them in line, and ground first on the bottom, then the beveled sides, and lastly the top. The faces where the two halves come together are lapped to insure a perfect joint. The dies may now be replaced in the bolster and, having been adjusted as before, are then ready for operation. FRANK E. SHAILOR.

New Haven, Ct.

CLASSIFICATION OF MACHINERY AT THE ST. LOUIS EXPOSITION.

As far as now determined, the exhibits of machinery at St. Louis will be grouped under five headings, as follows: Prime Movers; Transmission of Power; General Machinery; Machine Tools; Arsenal Tools. It is not stated in the information at hand whether the section "General Machinery" will include agricultural machinery, printing machinery, typewriters, automobiles, and other lines not specified above, or whether these will be displayed in other departments of the exposition. The information so far furnished is as follows:

PRIME MOVERS.—The generation of power from steam will be shown by the operation of all the items which go to make up a complete plant. This will include boilers and their accessories in operation, such as appliances for boiler feeding, water purifiers, fuel economizers, superheaters, chimneys, smoke consumers, grate bars, flue cleaners. The appliances for the transmission of steam, which include systems of steam piping, joints, gaskets, valves, traps, separators, condensers, etc., will lead to the prime movers using steam. Every type of steam engine, whether stationary or portable, reciprocating or rotary, will be included, together with such parts as may need special mention, such as valve gears, governors, and apparatus for lubrication. To this group will be added all other vapor engines, hydraulic motors, and the apparatus for testing the above machines. These latter will include turbines, water wheels of the tangential type, water pressure engines, etc.; gas engines and the kindred types of petroleum, carbonic acid gas, alcohol and compressed air motors; also the parts and fittings for such machines, and various other motors not specified.

TRANSMISSION OF POWER.—Such appliances as are essential to the transmission of power, and go to make up the last factor in the development and use of power. Under this head will be found shafting, pulleys, belts, cables, lubricators, etc., while in the proper delivery of the power thus generated will naturally be associated such apparatus as is necessary to record its performance. Thus we will find here, counters, speed indicators, dynamometers, weighing machines, testing machines, etc.

GENERAL MACHINERY.—Machines for moving heavy bodies, including cranes, hoists, conveyors, etc., all machines for raising water, such as pumps, hydraulic rams, and systems of piping for gas, water and air. Ventilators and blowers will be included in this group. To it will also be added fire engines, hose, and all apparatus used by firemen.

MACHINE TOOLS.—Machines for working in metal and wood will be included in this classification. In this section will be found steam hammers, machines for punching, shearing, etc., methods for working metals and the tools used in connection with these processes. Automatic machine tools, and all machines with cutting tools, such as planers, millers, drills, lathes, etc., together with such machines as are used for grinding and polishing will also be exhibited here.

Hand and hand with the advancement in metal working machinery are machines for working in wood. These include machines for sawing, planing, turning, etc., for polishing and veneering, and special machines, such as nailing, box and basket making machinery. To these classes will be added such hand tools as are essential in their manufacture, including vises, files, taps, dies, knives, graving tools, etc.

ARSENAL TOOLS.—The increasing perfection in the world's armament and the improvements in all kinds of firearms, have brought with them the necessity for special tools, and methods of shop practice. That these facts may be recognized, these machines have been set apart in a special grouping known as "Arsenal Tools." This will include machines for forging, milling, polishing, etc., in the manufacture of guns and different arms. Also tools for the manufacture of cartridges and ammunition for both military and sportsmen's use.

* * *

According to *Poor's Manual* for 1902 the total railroad mileage in the United States on December 31, 1901, was 198,787 miles, or practically now 200,000 miles. One-half this mileage has been built since 1882.

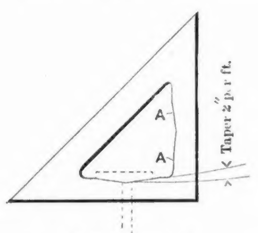
CONTRIBUTED NOTES AND SHOP KINKS.

SCALES WITH 1-100 GRADUATIONS.

X. Y. Z., Richmond, Va., writes: Many mechanics when they buy new scales still buy those without any tenths or hundredths graduation. All the principal manufacturers of scales make them and sell them at the same price as the old timers. Every up-to-date shop is using the decimal system in laying out work. It may therefore be well for apprentices and other mechanics who need new scales to buy the tempered ones with the 1-100th graduations along with the 1-16, 1-32 and 1-64 graduations; that is if they are not decided which to get.

A TRIANGLE KINK.

P. P. P. sends a drafting room kink which should prove of convenience to anyone engaged in structural drafting. Cut

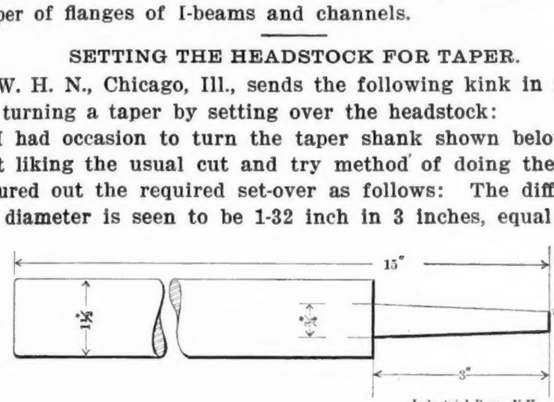


out the inner edges of the triangle to a taper of 2 inches per foot, as shown at *A*, *A*. This gives the proper angle for the taper of flanges of I-beams and channels.

SETTING THE HEADSTOCK FOR TAPER.

W. H. N., Chicago, Ill., sends the following kink in regard to turning a taper by setting over the headstock:

I had occasion to turn the taper shank shown below and not liking the usual cut and try method of doing the job I figured out the required set-over as follows: The difference in diameter is seen to be 1-32 inch in 3 inches, equal to an



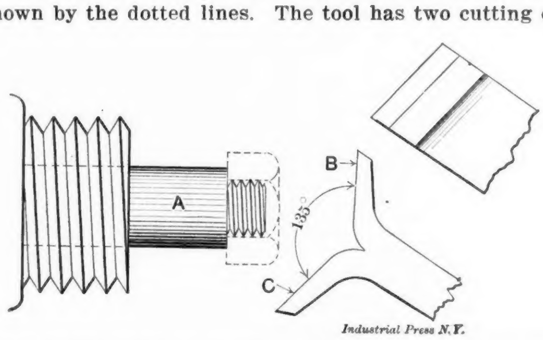
axial taper of 1-64 inch. For a total length of 15 inches this would be 15-3 × 1-64 = 5-64. This is the amount that the tailstock must be set over.

Now the set-over screw had 12 threads per inch, so to give an advance of 5-64 inch it must be given 5-64 ÷ 1-12 times = 60-64 or 15-16 of a turn.

By putting a line on the side of the setscrew I was able to estimate the 15-16 of a turn very nearly, so that after the trial cut, the adjustment had to be altered but very little.

TOOL FOR FACING AND CHAMFERING NUTS.

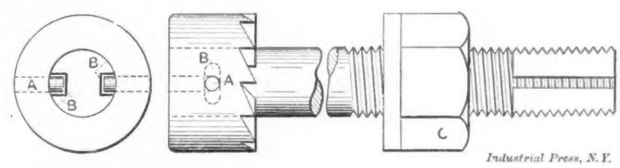
G. M. Strombeck, Moline, Ill., sends a sketch of a tool that he uses for facing and chamfering nuts in the lathe. The arbor *A* fits the hole in the end of the lathe spindle, and has a short thread at its outer end onto which the nut is screwed, as shown by the dotted lines. The tool has two cutting edges,



B and *C* which make an angle of 135 degrees with each other. The nut is first faced with the edge *B*, and then chamfered with the edge *C*, after which it is removed, turned around and the bottom finished with the edge *B*, this completing the operation.

A BACK-FACING BAR.

Mr. Fred. Harrison, Philadelphia, Pa., sends us the sketch of a back-facing bar which, he claims, is a great improvement on the ordinary facing bar with a double cutter that is continually breaking. The object of this cutter is to do away with the keys which, in the old-style bar, are used to hold the cutter up. A rose milling cutter, after being hardened is fitted with the pins *A A*, while the end of the bar is fitted with slots *B B* for the reception of these pins. By this arrange-



ment it is necessary only to slip the cutter on the end of the bar when a slight turn locks it securely in place. When the work is completed the cutter is simply turned forward and slid from the end of the bar.

A nut *C* provides for feeding the cutter up to the link. The upper end of the bar is made square for the reception of a wrench, or it may be made tapering and the bar driven by power.

SPECIAL LATHE DOG.

C. D. King, Brooklyn, N. Y., sends us a "kink" that he has used for turning pieces having a square head, as shown in Fig. 1, but which will be found equally convenient for turning bolts or anything of a similar shape. It consists of the sheet steel

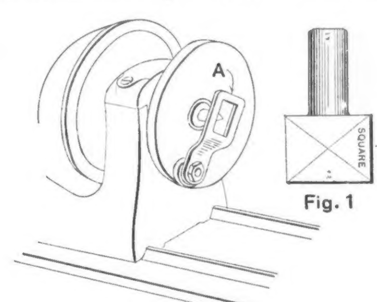


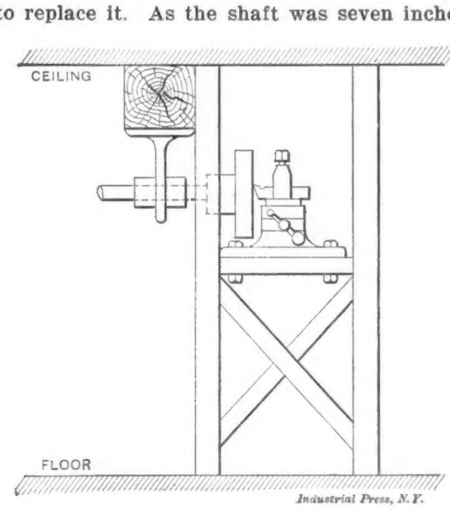
Fig. 1

Fig. 2

piece *A* which is bolted to the faceplate, as shown in Fig. 2. In this strap is a slot through which the head of the bolt is passed when it is put onto the lathe center. The sides of the slot serve to drive the work, thus dispensing with the use of a lathe dog.

HOW A FLANGE COUPLING WAS REPAIRED.

R. H. Hampson, Anniston, Ala., sends us an account of a rather ingenious repair job which he recently performed. The coupling of a jack-shaft had become loose and it was desired to replace it. As the shaft was seven inches in diam-



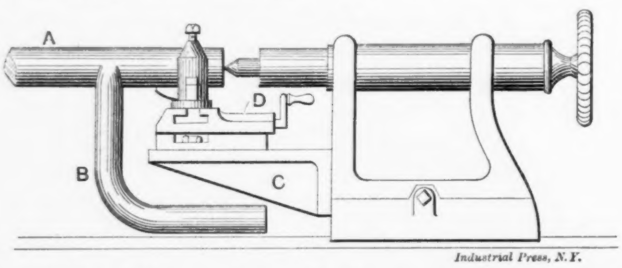
eter and the pulleys were keyed on solidly, it would have been a very long and expensive job to have removed them in order to turn the shaft in a lathe; so the work was ac-

complished in the very simple manner shown in the sketch. Four pieces of 2x4 inch timber were securely fastened to both floor and ceiling and firmly cross-braced. At the proper height a platform was constructed, upon which was mounted a carriage taken from a lathe. The old coupling having been removed, the engine was run slowly and the shaft re-turned. The new coupling was then shrunk on and faced off in the same manner that the shaft had been turned.

TURNING AN AWKWARD SHAFT.

G. F. H. sends us the following:

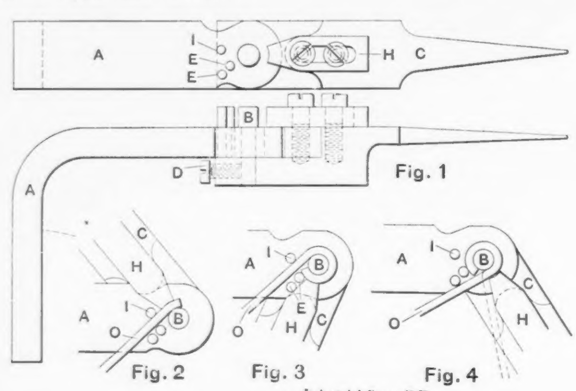
The shaft shown in the figure was recently brought into the shop to have its journals re-turned, as they were badly worn. The curved arm, *B*, extended 6 inches beyond the end of the shaft, and when we had placed the shaft in the center of our 48-inch lathe we found we had not sufficient room to



operate the lathe carriage. Finally we clamped the angle plate *C* to the front side of the tailstock and on this mounted the tool rest taken from a small lathe, as shown at *D*. Although we were obliged to feed this carriage by hand, we were able to do a very satisfactory job with this arrangement.

TOOL FOR BENDING EYES AND HOOKS.

C. D. King, Brooklyn, N. Y., describes a device which he recently made for bending eyes and hooks from wire. It consists of the angle piece *A* and the bending lever *C*. When in use, the angle piece is clamped by its lower end in a vise, shown by the dotted lines in Fig. 1. The bending lever is pivoted about the pin *B*, which is held in place by the set screw *D*. The pins *E*, *E* and *I*, are driven into the upper end of the angle piece *A*, which is cut away on either side to give sufficient swing for the lever *C*. This lever has a tang on which is driven a wooden handle, not shown, by which the fixture is operated, while on top is fastened, by two screws, the slotted movable finger *H*, which is adjusted for various sizes of eyes and wire.



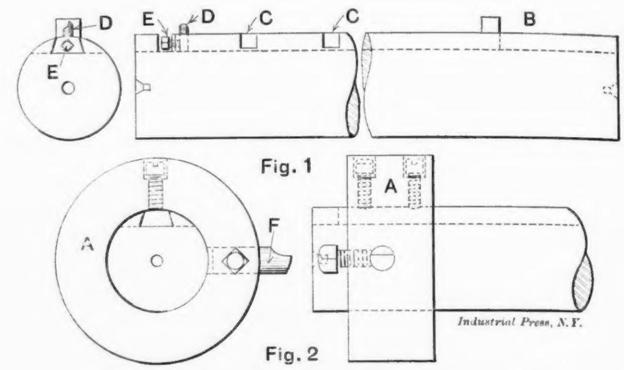
Hook and Eye Forming Tool.

The process of bending is as follows: The straight piece of wire *O*, Fig. 2, is slipped in between the pin *B* and the finger *H*, after the handle *C* has been brought to the starting position, as shown. *C* is now moved clockwise until it comes to the position shown in Fig. 3, and cannot go any farther as the finger *H* comes against the pins *E* and *E*. In these operations the pin *B* turns with the finger *H*, the wire being pinched between them by the bending action of the pin *I*, and the eye is completed all but giving a radial bend. It is now reversed, as seen in Fig. 4, and a small movement of the part *C* toward the left brings the stem *O* radial with the ring as indicated in dotted lines.

Several sizes of former pins *B* will be required for various sizes of eyes.

A CONVENIENT BORING BAR.

Those who occasionally have a small job of boring to do in the lathe will find such a bar as is described by W. W. Cowles, Waterbury, Conn., to be very practical and convenient. This bar is made from cold-rolled steel of any diameter and length, depending upon the work to be done. A dovetail slot is planed the entire length of the bar and fitted with the sliding rod, one end of which is turned up as shown at *B*, while the other end is drilled for the tool *D* that is held in place by the setscrew *E*. In boring out a long hole, where the work can be revolved by the face-

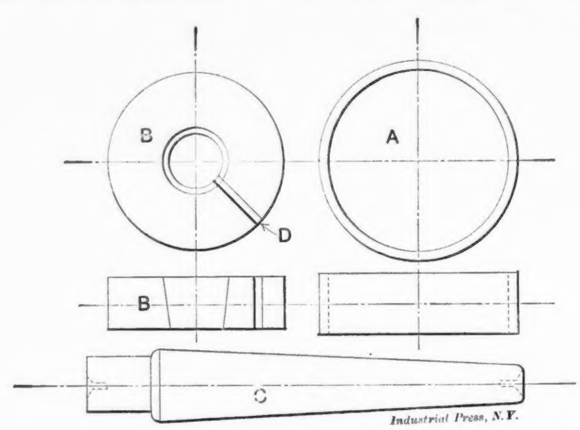


A Simple Boring Bar.

plate and supported at the outer end by the center rest, the bar is placed on the lathe centers and prevented from turning by a dog against the tailstock. A tool is placed in the tool-post and the carriage run up until the tool strikes the lug *B*. By throwing in the feed the bar will now be pushed through the piece to be bored. Slots *C C* will have to be cut in the bar at intervals so that a wrench can be used on the set screw in the end of the feed rod. For boring larger holes the collar *A* is slipped over the bar and fastened to the feed rod by two screws as shown in Fig. 2. The cutter is then fastened in the collar as at *F*.

TURNING PISTON RINGS.

"Student" sends a "kink" which he has used for turning the outside of piston rings. The rings, shown at *A*, are first roughed out in a turret lathe and bored to the required inside diameter. The outside turning and facing off of the ends is done on the expanding head *B*. This head is bored to fit



Rig for Turning Piston Rings.

the taper arbor *C* and turned to fit loosely the bore of the rings. It is made narrow enough so that the ends of the rings project on either side. The ring is slipped onto the head and the taper arbor forced into the hole. The slot *D* in the head allows it to expand and firmly clamp the ring which is then finished in the lathe.

* * *

In boring long cast iron tubes, say 16 inches in diameter, excellent results have been obtained by the use of kerosene as a lubricating agent. The holes were bored with a "packed bit," of the type used for gun boring and were finished as smooth as glass.

ITEMS OF MECHANICAL INTEREST.

LARGEST PULLEY BUILT—READING VERNIER CALIPERS—A TAKE-UP DEVICE FOR INDICATORS—NEW BELT LAW—HYDRAULIC BEAM SHEAR.

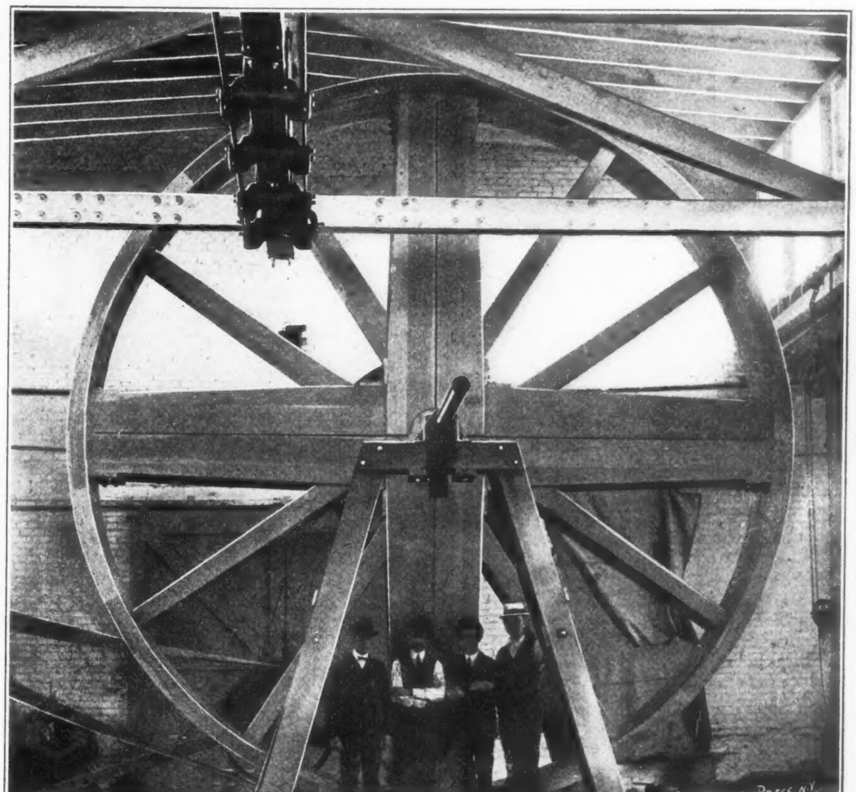
The *Canadian Electrical News* quotes a curious circumstance illustrating the difference in speed between sound, which travels through the air, and electricity through wire as its guide and conductor, that occurred in California. A certain powder works blew up in a town while a railway telegraph operator was telegraphing to another in a neighboring town. At the instant of the occurrence he telegraphed the news to the operator, who, sixty seconds afterward heard the report of the explosion. He knew it had occurred by wire just one minute before he heard the report. Sound travels at about the rate of 1,140 feet per second, while electricity accomplishes 186,000 miles in the same short period of time.

One of the changes likely to be made by the general use of electric power, is the displacement of the steam fire engine by the electric motor pump. Already in France the electric fire pump has been tried with success, being much lighter to handle and quicker to get into operation. One horse draws the pump to the fire and connection is made with the street car line circuit. The moment connection is made the pump is ready for business, and expense for power ceases the moment the current is shut off. If such a system of fire protection was developed for a city it would probably be that each fire hydrant would also be an electric "hydrant" having a socket for connecting the wires leading to the motor driving the pump. The system of electric mains could be laid underground and parallel with the water mains, where they would be reasonably secure from accidents.

A correspondent of the *Scientific American* suggests that calcium carbide may be used for quickly obtaining heavy pressures and that it might be made useful for baling cotton, hay, straw, and for many other kinds of work where heavy pressure is required for brief intervals of time. Its merit would lie in the simplicity of the apparatus. He has experimented with a four-foot steel pipe capped at one end and provided with a cap and stuffing box at the other end, through which a turned shaft was inserted carrying at its lower end a basket for the carbide. A release cock and gage reading to 400 pounds were also provided. The pipe was filled with water to a depth of six or eight inches. On lowering the carbide basket to the water and forcing the air out of the pipe, a second quick plunge forced the gage around to 400 pounds in three seconds.

A labor-saving device of the first order is a hydraulic tire setting machine for wagon wheels. The ordinary process of taking the tire off the wheel, cutting out a section, and welding the ends together, as followed by many blacksmith shops, takes considerable time and labor and is usually an unsatisfactory job in a number of ways. The distance between the bolt holes that straddle the weld is shortened, and unless the blacksmith is quite skillful the wheel is likely to be "dished" too much. With steel tires there is also the difficulty of getting perfect welds. To be sure there are tire upsetting machines which shorten the tire circumference without cutting and welding, but these require the tires to be removed from the wheels. The device referred to consists of a horizontal frame carrying, say, fourteen plungers attached to the inside of a strong circular ring and all pointing toward the center. The wheel with the tire in place is laid in the center of the ring so that the plungers bear on the tire. Then all are forced inward at the same time with a water pressure that may be carried up to 2,500 pounds per square inch. The amount the tire is shortened is under perfect control and consequently the amount of "dish." No dismantling or heating whatever is necessary. It is claimed that a tire can be set in one minute.

The use of graphite in soft paste form for lubricating bicycle and automobile chains, is by no means new, but its use in the form of cakes having a moderately high melting temperature, is comparatively so. Chain graphite is prepared in this form, by the Dixon Company, that requires a temperature of about 180 degrees F. to melt and it is to be applied to the chains while hot. It is melted in a shallow pan large enough to contain the chain coiled in a close spiral. The chain (which should be well-cleaned) is dipped and allowed to remain for some several minutes. This gives time for the air around the joints to escape and allows the graphite to penetrate to all the working parts. The advantages of chain graphite prepared in this manner, are that it forms a solid bushing around each rivet that is not easily displaced, and that it does not attract the dust and dirt of the highway.



Largest Wood Pulley ever Built.

A MONSTER WOOD PULLEY.

What is believed to be the largest wood pulley ever built was lately made by the Reeves Pulley Co., Columbus, Ind. This pulley, which is illustrated in the accompanying half-tone, is 20 feet in diameter, has a face 30 inches wide, and is bored for an 18-inch shaft. Although larger than anything ever before attempted by the Reeves Co., this pulley was completed within 20 days from the time that the order was received. It was furnished to the Taunton-New Bedford Copper Co., New Bedford, Mass.

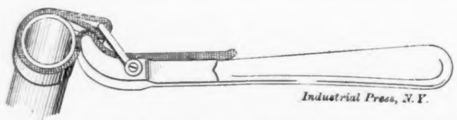
AN ELECTRIC WHIP.

While of no particular importance as an invention, a Georgia mail carrier has produced an electric whip which has the merit of novelty. He drove a letter carrier's wagon with doors that could be closed in case of rain. In stormy weather he naturally disliked to open one of the doors in order to reach out and apply the lash to his equine, which, being an intelligent animal, naturally took advantage of this situation and always lagged in rainy weather. To overcome this propensity

the Georgia Edison attached a pair of copper plates under the harness saddle and connected them by wire to a hand operated dynamo in the wagon. When the steed began to jog up and down, without making much advance, it was time to turn the dynamo crank, which gave the horse a very evident wish to get over the ground more rapidly and almost any desired speed could be obtained, according to the number of rotations per minute given the dynamo armature. An apparatus is now contemplated, says the *Atlanta Constitution*, which paper has the distinction of first telling about this invention, for use on plows, whereby both the mule and plow hand shall be automatically shocked every few minutes. It is believed that such an attachment would find a tremendous sale all over the south, as by its use farmers could be very sure that no darkey would go to sleep between the plow handles.

WRENCH FOR SMOOTH PIPE AND TUBING.

The wrench shown in the cut has recently been brought out for use on polished pipes and tubing, where the scratches caused by the use of an ordinary wrench would mar the appearance of the pipes, or perhaps, of the entire machine. The canvas strap is passed around the pipe and held firmly by the



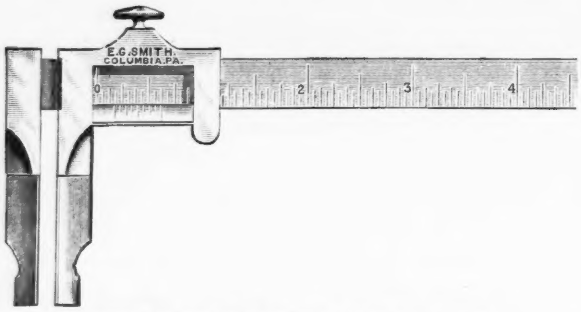
A Novel Pipe Wrench.

pressure of the toe of the wrench, thus securely gripping the pipe without bringing any metallic part of the wrench in contact with the polished surface. The simple ratchet movement by which the wrench is operated, renders it especially convenient for use in close quarters, while its wide range makes it equivalent to three sizes of ordinary wrenches. An 18-inch wrench is applicable to all sizes from 1 inch to 5 inches in diameter, while a smaller size takes all pipe 1 inch diameter and under. This wrench is made by the Warnock Mfg. Co., of Boston, Mass.

READING VERNIER CALIPERS.

The application of the vernier to beam calipers, for fine measurements, usually in thousandths, is familiar to most machinists. Less familiar, but equally convenient, is the use of the vernier for making the ordinary scale measurements in 16ths and sub-divisions thereof.

The cut shows a beam caliper with vernier slide, by the use of which measurements are made in 128ths of an inch. The beam is divided into 16ths of an inch, while a space of 7-16



Vernier Caliper for Reading in 64ths and 128ths.

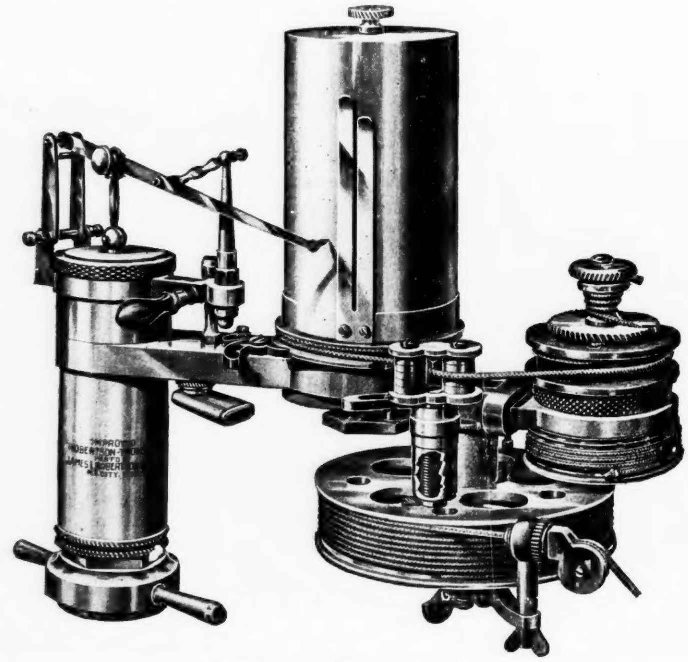
on the vernier slide is divided into eight divisions, each one of which is consequently 1-128 inch less than 1-16. Now if the 0 line of the scale has passed a certain mark on the beam and the line at the right of the first space, on the scale, coincides with a line on the beam, then 1-128 inch must be added to the reading of the mark passed by the 0 line. If two spaces on the scale are passed before two lines correspond then 1-64 is added, and so on. In the cut it will be seen that the left hand, or 0 line, of the scale, has passed the ⅛ line on the beam and seven spaces on the scale have been passed before a line on both scale and beam coincides. Therefore 7-128 must be added to ⅛ to give the reading of the opening between the jaws of the caliper, that is 23-128 inch.

This method of graduating makes working to the ordinary scale dimensions a matter of much more accuracy than is possible with the use of the ordinary caliper and steel scale, besides being far easier on the eyes of the machinist. Calipers of the kind described are manufactured by E. G. Smith, Columbia, Pa.

A TAKE-UP DEVICE FOR USE IN CONNECTION WITH THE DETENT OF THE INDICATOR.

The majority of indicators in use at present are provided with a detent by means of which the paper drum is stopped and held stationary so that cards may be taken off and new ones put on without unhooking the cord from the crosshead. The great trouble that has been experienced in using the detent on the indicator has been caused by the slack of the cord between the drum and the reducing wheel. This slack, if not properly guided, is very likely to get fouled with some parts of the indicator and if the instrument is not wrecked the cord at least is broken, causing delay and inconvenience to the operator. In order to overcome this trouble a take-up device, which may be attached to any style of indicator, has lately been devised.

A short horizontal arm, which is fastened to the indicator, is provided at the outer end with a vertical bearing, at the upper end of which is a frame carrying two sets of steel rollers. Between these rollers passes the cord from the drum to the reducing wheel. On the lower end of the vertical bear-



Indicator with Take-up Device.

ing is a light enclosed spiral spring which causes the upper frame to revolve when the cord becomes slack as is the case when the detent is thrown in. The arrangement is such that as soon as the detent is thrown in, the cord from the reducing wheel, which ordinarily winds and unwinds from the barrel, is now automatically wound on the take-up frame while the barrel remains stationary. The spring in the take-up is so much weaker than that in the barrel that as soon as the detent is thrown out of action the cord immediately becomes taut between the drum and wheel and slides freely between the two sets of rollers on the vertical frame.

The illustration shows the device as attached to one of the standard indicators. It is manufactured by James L. Robertson & Sons, New York.

A NEW BELT LAW.

The old law that the efficiency of a belt for transmission of power increases with its initial tension (to the limit of practical strain, of course) is so commonly accepted that the following results, directly opposed to that law, and which were sent us by the Cling-Surface Mfg. Co., Buffalo, N. Y., are of considerable mechanical interest.

Two new and identical 4-inch belts were used, leading from two similar 8-inch pulleys on the single shaft of a 10 horse power motor to two similar 12-inch pulleys on two similar

generators. The centers were 8 feet. One belt had been treated with Cling-Surface, the other was as it came from the maker. A wattmeter was connected to each generator, and circuit and switches were arranged to throw full load on either generator. In the one case, intimate contact between belt and pulley was secured by the application of the Cling-Surface preparation and the tests showed that such a belt would not only run slack under full load, but would transmit

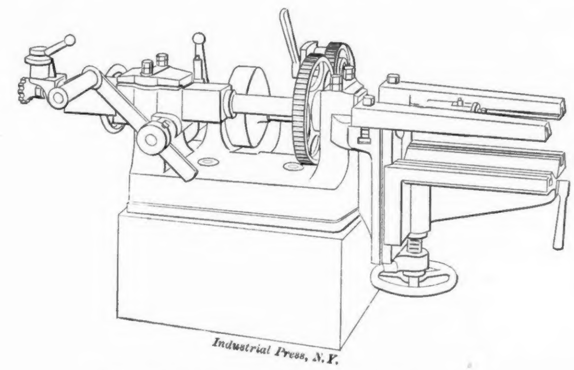


Fig. 1. Machine for Cutting Oil Grooves.

more power when running slack than when running tight. This is due to the increased belt and pulley contact and great reduction of friction load. In the other case the frictional resistance between pulley and belt could be maintained only by increasing the tension and consequent normal pressure upon the pulley face, as the load increased. This resulted in increased friction load, and a reduction in the proportionate amount of power transmitted. The wattmeter readings were as follows:

Four-inch Belt with Cling-Surface.

At 54 pounds initial tension, transmitted 7 3-5 horse power.
At 40 pounds initial tension, transmitted 7 4-5 horse power.
At 30 pounds initial tension, transmitted 8 1-5 horse power.
At 20 pounds initial tension, transmitted 8 4-5 horse power.
At 15 pounds initial tension, transmitted 9 1-5 horse power.
At 10 pounds initial tension, transmitted 10 horse power.

At this point with $8\frac{1}{2}$ pounds initial tension on the belt the slack was so great that there was only $2\frac{3}{4}$ inches between the upper and lower side of the belt in the center.

Four-inch Belt without Cling-Surface.

At 54 pounds initial tension, transmitted 7 3-5 horse power.
At 45 pounds initial tension, transmitted 6 horse power.
At 40 pounds initial tension, transmitted 5 1-5 horse power.
At 35 pounds initial tension, transmitted 4 3-5 horse power.
At 30 pounds initial tension, transmitted 4 horse power.

At 20 pounds initial tension, transmitted 3 2-5 horse power and there stopped. The belt here slipped around the pulley and would transmit no more power.

MACHINES FOR CUTTING OIL GROOVES.

Any machinist who has cut oil grooves in a long bushing with a hammer and chisel will be interested in the machine shown in Figs. 1 and 2, which is designed for doing this and similar kinds of oil groove cutting. Fig. 1 shows a general

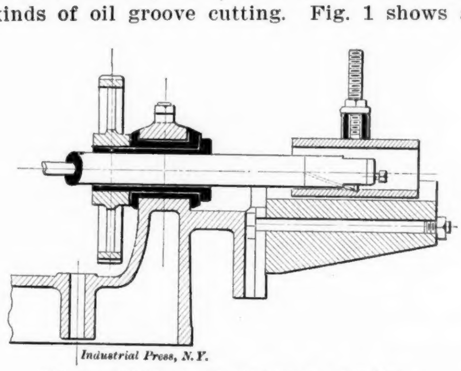
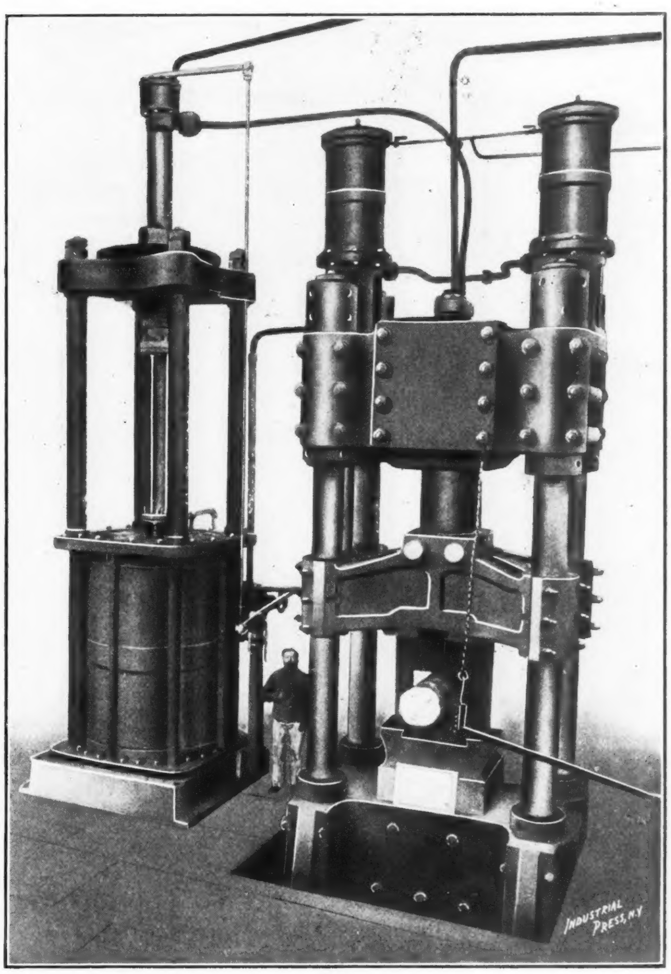


Fig. 2. Cutting an Oil Groove in a Bushing.

view of the machine, which is clamped to a bench in the same manner as a vise. The work is supported in a V rest which has an up-and-down adjustment operated by means of a handwheel. The tool is held in a bar and drawn through the hole in a manner similar to the action of a draw-cut shaper. By the provision of change gears, reversing gears and a friction clutch, it is possible to cut oil grooves straight, spiral, (right or left hand) or straight with spiral starting and ending. A micrometer feed and adjustable stop are provided for regulating the depth of the groove. The machine does better and more effective work than can be done by hand besides keeping collected together the chips that, when the work is done by hand, fly all over the shop. It is made by C. W. Burton, Griffiths & Co., Ludgate Square, London, E. C.

ELECTRICALLY-OPERATED HYDRAULIC SHEAR.

Robert Grimshaw, Hanover, Germany, sends a photograph and brief description of an electric hydraulic beam shear, which in points of size and design is somewhat unusual. The machine consists of the shear proper and a pump driven by a 10 horse power electric motor. The shear has two cast-steel stands that are connected by a single steel casting which also forms the cylinder. The piston of the latter, which has leather packing, has at its lower end the tool-holder, which has side



German Hydraulic Beam Shear.

guides on the stand and receives in the best possible manner the side pressure unavoidable in shearing off beams of varying resistance. The lower guide prevents the tool from moving in a fore-and-aft direction. The stationary lower knife and the side knives are directly between the halves of the stand. These side knives may be adjusted by means of a spindle and hand wheel.

After the bar has been cut off, water is admitted to the two reversing cylinders, shown at the top of the side columns. The pistons of these cylinders are connected with the sides of the tool holder and by them the shear is returned to cutting position. The water supply for both cylinders is controlled by valve gear on the side of the housing. The pressure pump, which is at the side of the machine, has a double piston. At first both pistons are in action, so as to expedite that part of the stroke where no work is being done; then, as soon as resistance is felt, one piston is thrown out and correspondingly higher pressure put on.

NEW TOOLS OF THE MONTH.

A RECORD OF NEW TOOLS AND APPLIANCES FOR MACHINE SHOP USE.

COMBINATION TOOL FOR MACHINING STEAM ENGINE CYLINDERS AND FRAMES AT ONE SETTING.

One of the latest productions of the Beaman & Smith Co., Providence, R. I., is the combined milling and boring machine illustrated in Figs. 1 and 2. It is designed for machining small-sized engine frames of the type having cylinder, bed-plate and crank-shaft bearing combined in one casting. Upon this machine these frames can be machined complete at one setting. A main boring spindle bores out the cylinder and faces it for the head, a milling cutter finishes the cross head guides, and a secondary boring spindle bores and faces the sides of the crank-shaft bearing.

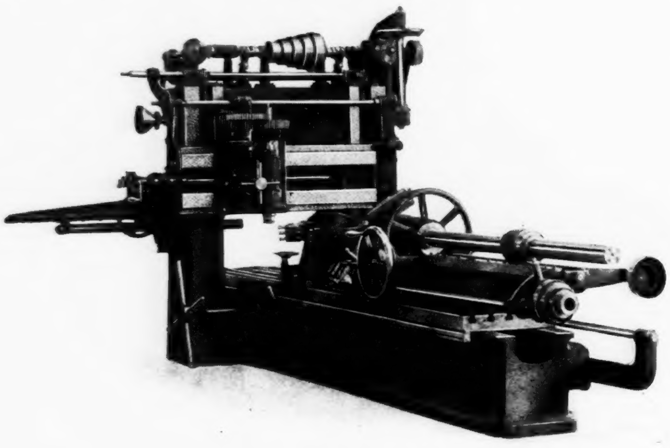


Fig. 1. Cylinder Machine, Front View.

The main boring spindle is 4 inches in diameter and is driven by a 3½-inch belt running on a five-section cone. A spindle speed of 20 feet per minute is suitable for boring cylinders from 4 to 19 inches in diameter. This spindle has a feed of 50 inches and will feed at the rate of 4, 6, 12, or 36 revolutions per inch of travel, in either direction. The facing capacity is from 4 inches to 24 inches in diameter and the tool feed, either in or out, is 1-30, 2-30, or 3-30 inch per revolution. Each facer has a fine adjustment, on its table, of 6 inches. This machine will bore and face cylinders up to 40 inches in diameter.

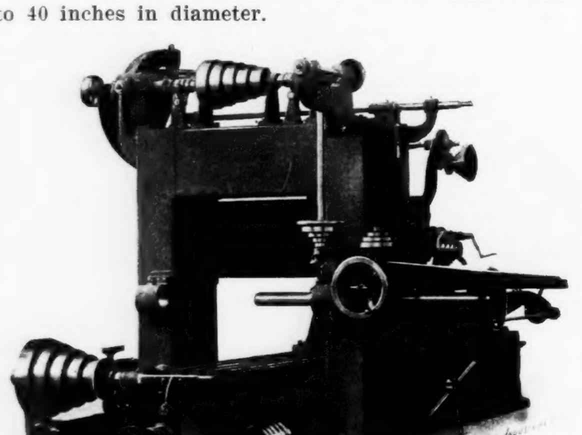


Fig. 2. Cylinder Machine, Back View.

The milling spindle, shown on the cross rail, is driven by a 3-inch belt on a five-section cone, giving speeds from 10 to 102 revolutions per minute. These speeds are suitable for cutters from ¾-inch to 7 inches in diameter running at a cutting speed of 20 feet per minute. The milling feeds run from 7 to 4 inches per minute at all speeds. The spindle has a feed on the cross rail of 40 inches and is adjustable above the table from 10 to 33 inches, 6 inches of which is the spindle head adjustment in the saddle.

The spindle used for boring the crank-shaft bearings is 3 inches in diameter and has a feed of 36 inches. It is driven by a 3-inch belt on the same cone that is used for driving the milling spindle, since the milling spindle and the crank-shaft boring bar are not used at the same time. Suitable clutches are provided for shifting from one mechanism to the other. This bar has boring speeds of 12, 16, 21, 28 or 37 revolutions per minute and is suitable for boring, at 20 feet per minute, from 2 to 6 inches in diameter. The feeds are 13 1-3, 40, 80 and 120 revolutions per inch of travel.

The table is 14 feet long and 24 inches wide, the working surface, from end of table to facing tool, being 8 feet and 3 inches. It is driven by a 3-inch stationary feed screw on which is a revolving nut provided with anti-friction ball bearings at each end. The feed is from 2 to 16 inches per minute, in either direction, regardless of milling spindle speeds. It has an automatic stop and a fast movement of about 15 feet per minute in either direction besides the hand movement. There is a clamping arrangement by which the table is locked when the machine is being used for cross milling or for boring crank-shaft bearings. The traverse of the table is about 9 feet 6 inches and the distance between uprights 40 inches. The boring spindle centers are 15 inches above the top of the table. The weight of this machine is about 25,000 pounds.

BICKFORD DRILL AND TOOL CO.'S TREPANNING MACHINE.

Fig. 2 (next page) shows some drill chips that, by comparison with the three-inch scale, will be seen to be of quite unusual size. These chips were made with a four-inch flat drill operating in solid .45 carbon steel at the rate of 1¼ inches per minute, feed .072 inch per revolution, using water as a lubricant.

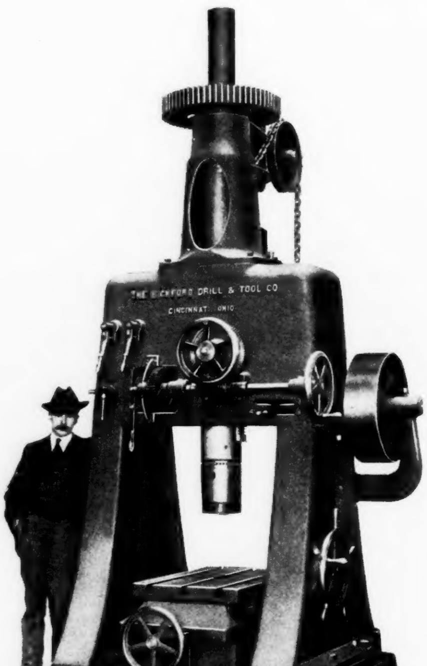


Fig. 1. Three-foot Trepanning Machine.

The machine with which this work was accomplished is illustrated in Fig. 1. It is termed a three-foot trepanning machine and is the product of the Bickford Drill & Tool Co., Cincinnati, Ohio. This is designed for all kinds of heavy drilling, facing, tapping and trepanning and is capable of receiving work 36 inches wide, between the housings. The head and cross rail are made in one piece, so designed as to eliminate all overhanging of the spindle. The table is adjust-

able both transversely and longitudinally, and when not needed may be slid back out of the way, for which purpose an extension is cast on the base.

The spindle has 16 changes of speed ranging from 6 to 60 revolutions per minute, and eight changes of feed ranging

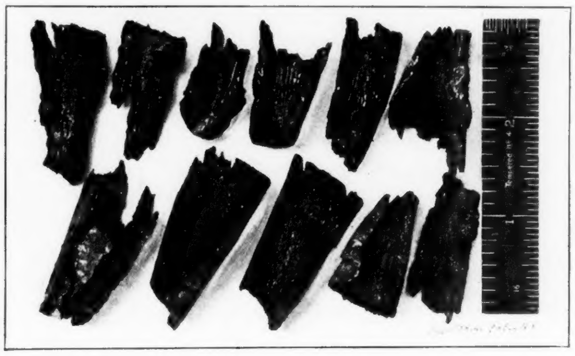


Fig. 2. Chips made with Bickford Trepanning Machine.

from .01 to .1 inch per revolution. All changes are accomplished by the movement of levers, no belt shifting being required. Both hand and power quick advance and return are also provided.

ELECTRIC BLUE PRINTING MACHINE.

In Figs. 1 and 2 is shown a new electric blue printing machine that has been placed on the market by the Eugene Dietzgen Co., Chicago. The general arrangement of glass cylinder with its canvas cover is practically the same that has been employed in former machines but for inserting the paper and tracing, the cylinder can be swung down into a horizontal position, making the manipulation much easier than is possible where it remains upright. After prints have been put on one side of the horizontal cylinder it is turned completely over and prints are placed on the opposite side. The cylinder is then tipped up and locked in a vertical position ready for printing. By touching a lever the arc lamp starts in its descent through the center of the cylinder at a speed that can be regulated to suit the sensitiveness of the paper employed. When the lamp has reached the lowest point of the printing surface it automatically reverses its motion and returns to its original position above the cylinder. The operating mechanism is all mounted on the back of the stand so that the machine is entirely self-contained.

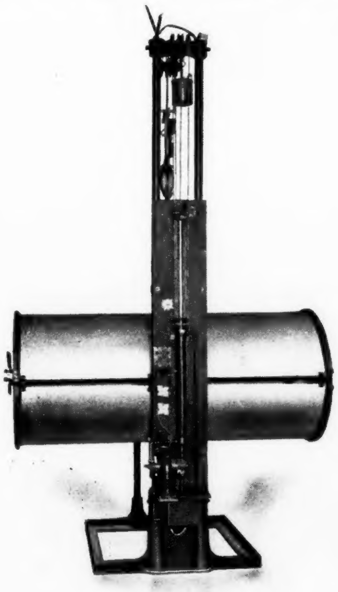
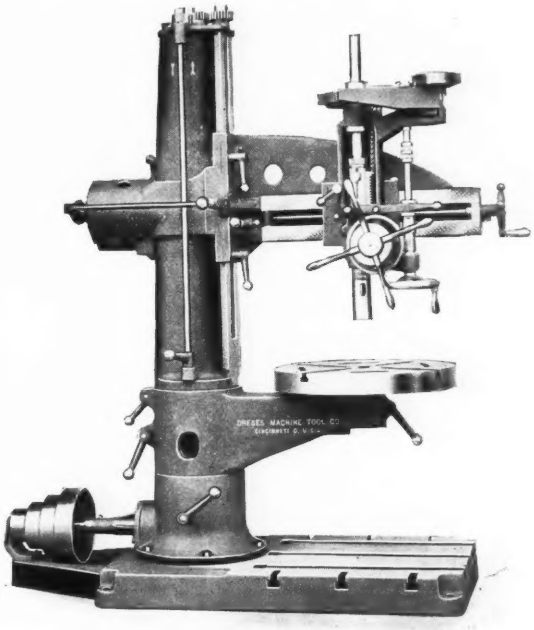


Fig. 1. In Position for Loading.

Fig. 2. In Position for Printing.

A NEW DRILL MANUFACTURED BY THE DRESES MACHINE TOOL CO.

The Dreses Machine Tool Co., Cincinnati, O, have just brought out a new radial drill which, after a thorough trial, is now ready for the market. The outline of this drill follows quite closely that of their old machines, only all vital parts have been made stronger and heavier. A lever, which may be seen protruding through the arm near the column, is used for quickly starting, stopping and reversing the spindle for tapping. It also engages the back gears according as its position is central, right or left. The little knurled head screw, passing through this lever, limits the brake power of the forward driving friction clutch and can be so adjusted that it just drives the tap but slips if the hole is too small,

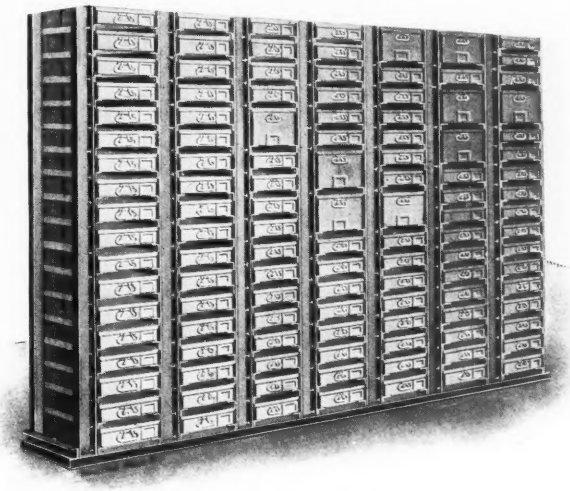


Dreses Machine Tool Co.'s Radial Drill.

or when the tap strikes the bottom of the hole or any other obstruction. In connection with the gearing on the two horizontal driving shafts are four friction clutches which are operated by two levers, while any one of four quick-return levers disengages the feed and operates the spindle. This is accomplished by a single movement with but one hand. There are four changes of feed which can be varied by shifting the knob on the feed rod while the machine is in operation. The spindle is provided with a depth gage and an automatic stop.

EXTENSIBLE STOCK DRAWER RACKS.

The "elastic" principle, which has long been employed by the Globe-Wernicke Co., for the construction of book cases in sections or units, has recently been applied by the Cleveland Wire Spring Co. to iron racks with steel boxes for holding tools, shop supplies, etc. One of these racks, consisting of seven sections, with drawers facing on both sides, is shown in the accompanying half-tone. A rack of this capacity is 8 feet high, 8 feet long and 32 inches deep, while the length may be increased indefinitely by the introduction of addi-



Rack of Steel Stock Drawers.

tional sections. The boxes are made of sheet steel with the angles turned on all corners, making a strong and durable box, which is very desirable in case of fire. One concern, recently burned out, lost almost all of their small tools except what they had in these trays, the contents of which were taken out practically uninjured.

These cases are used by a large number of firms who prefer them to wooden boxes on account of their convenience, cleanliness and durability.

THE NEW MODEL TURRET LATHES.

The Pratt & Whitney Co., Hartford, Conn., have recently re-designed two sizes of their new model turret lathes, retaining those features of the early machines which have proved of merit and adding new features for increasing the accuracy, capacity and convenience of the machines. While they are designed for manufacturing in large quantities, yet the tools of these machines may be set so easily that it is often of advantage to employ them for making as few as six pieces. The capacities of the two improved machines are, respectively, 5/8 x 4 1/2 inches and 1 x 10 inches, which latter is shown in Fig. 1. As will be noticed in this cut, the headstock, bed and pan are cast in one piece. This arrangement insures alignment of the head and bed, and connects the parts in the best possible manner. The reversed position of the cones permits the front bearing to be reinforced and better provides against springing when heavy cuts are being taken. The end thrust of the spindle is taken entirely on the main bearing.

A detail of the turret and turret slide is shown in Fig. 2. The slide runs directly on the bed of the lathe, thus avoiding any intermediate construction and making the alignment more permanent. The sliding surfaces are gibbed underneath so that the transverse alignment of the cutting tool is not disturbed in making adjustment for wear. On the 5/8 x 4 1/2 inch lathe the turret slide is moved by a lever, but on the larger size either lever or capstan wheel may be used, the change being quickly made from one to the other. The turret revolves about a heavy conical post which is bored, in alignment with the machine, to permit work being passed through the turret when necessary. The locking bolt, which is of steel, is provided with a taper gib and may be adjusted for wear without removing the turret from the slide. Locking takes place directly under the turret head, and no matter how quickly the turret may be indexed it is impossible for it to "over-run" or be carried beyond the index notch. When but two turret tools are used, the index mechanism may be thrown out by giving a partial revolution to the disengaging pin *P* Fig. 2. This allows the head to be indexed back and forth by hand between the two tools. The regular indexing is put into operation again by simply turning this pin back to its original position. On the base of the turret head is a cam *J* which, by acting upon the roller *K* and through the shaft *L*, causes the lever *M* to swing in or out as the turret revolves. The lever, therefore, occupies a series of positions corresponding to whichever hole of the turret is in working position. For each of these positions there is a stop, *S*1 *to* *S*6, which is adjusted to give the proper length of feed to its corresponding tool. The lever *M* at all times bears against the bracket *N*, so that when it comes in contact with one of the rods the feed of the turret slide is brought to a positive stop and no undue straining on the capstan wheel can in any way injure the turret mechanism.

The rod feed used on these machines is a modified form of the Parkhurst type of wire feed, the modification consisting in the use of a feeding sleeve operated through a link connected at a distance from the fulcrum point about double that at which the closing link is located. This construction permits, without sacrificing power in the closing mechanism, double the feed of rod to a given movement of the lever that can be obtained with the standard form of rod feed.

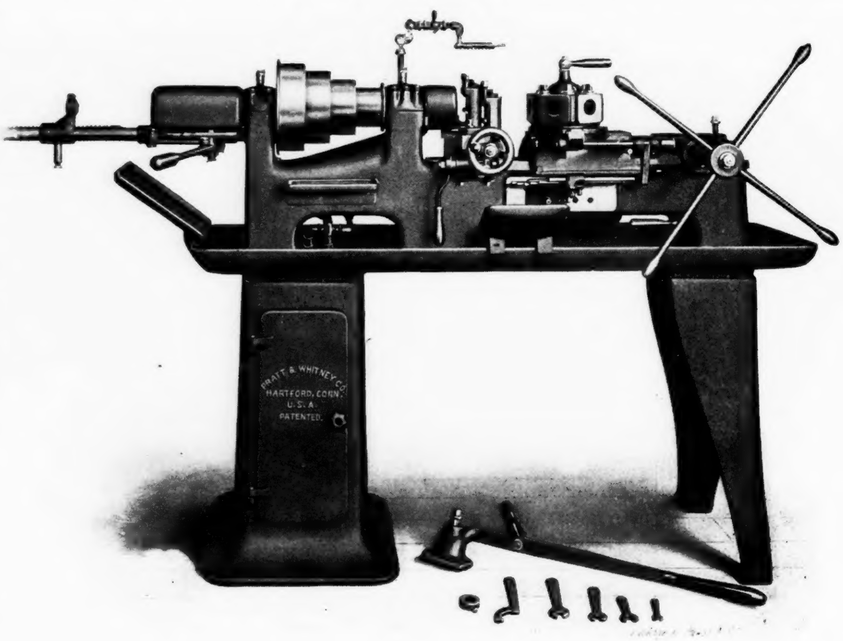


Fig. 1. 1 inch x 10 inch New Model Turret Lathe.

The collets are so arranged that, in closing, they do not withdraw or further advance the stock, a feature that is especially desirable in doing "second operation" work. For turning short pieces, such as rings or collars, which have a diameter above the capacity of the regular collets, split step chucks are supplied, thus materially increasing the range of work that these machines will handle. In these chucks the feature of the non-withdrawal of the chuck in closing is retained. By reason of the small diameter of nose-piece for a given diameter of collet it is possible to employ a heavy double cross slide directly under the collet and to support the cut-off and forming tools on the same without overhang. This slide may be placed anywhere between the headstock and the turret slides and rigidly clamped at any desired location.

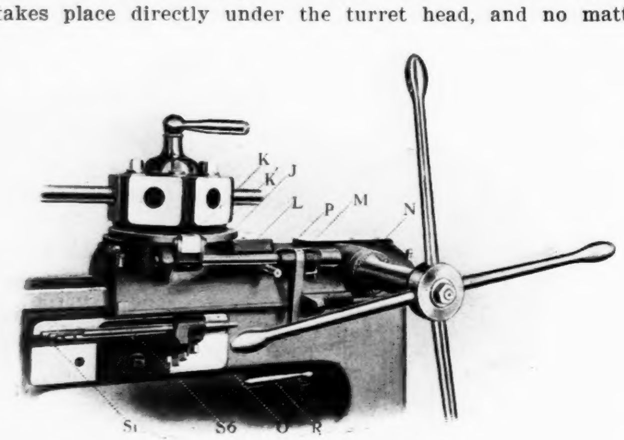


Fig. 2. Turret and Turret Slide.

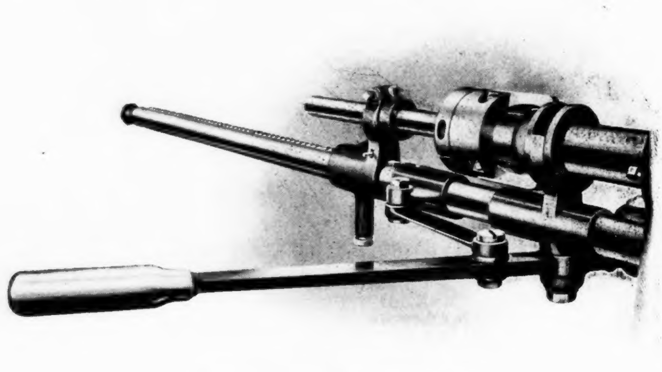


Fig. 3. Rod Feed Mechanism.

There are adjustable stops for the forming and cut-off tools. The tools may be operated by lever feed, if the work is light, or by handwheel and screw mechanism when the work is heavy or the tool not easily controlled by the lever.

The turret tools are made with a wide range of adjustment to cover a great variety of shapes. In Fig. 4 is shown the single roughing tool with steady rest. The cutter holder swings from a center so that the point of the tangent tool varies the least possible from the best cutting position, no matter how large or how small the piece operated upon may be. The cutter is adjusted by the screw at the top and locked by a clamp screw. When it is desired to withdraw the cutter, the clamp screw is loosened and the tool swung back. It is

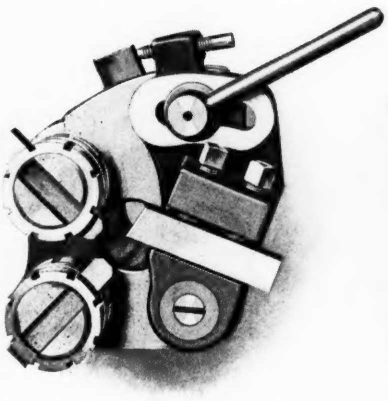


Fig. 4. Single Roughing Tool

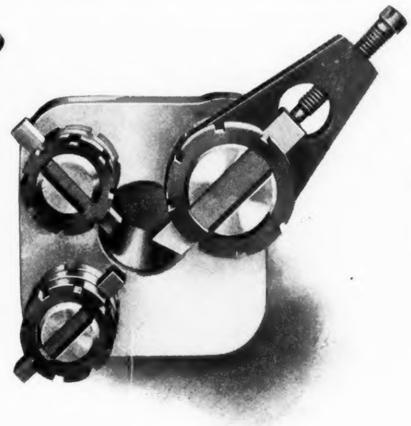


Fig. 5. Single Finishing Tool.

equally easy to return the cutter to its proper position by bringing the adjusting screw to the stop upon which it bears. The single finishing tool with steady rest is shown in Fig. 5. This tool has the same form of steady rest as the roughing tool but the cutter is held radially in a swinging arm.

On work having two or three shoulders a multiple tool, one of which is shown in Fig. 6, can be used to good advantage. The tool illustrated is a finishing tool but multiple roughing tools also are made for use with these machines.

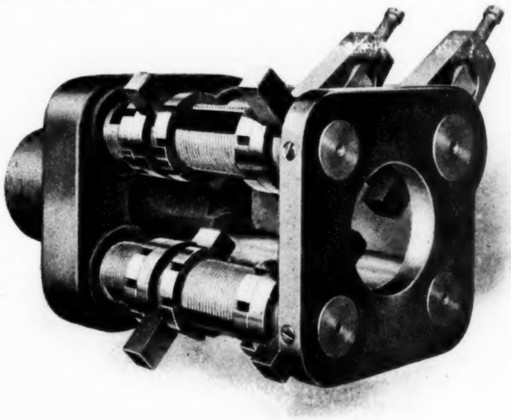


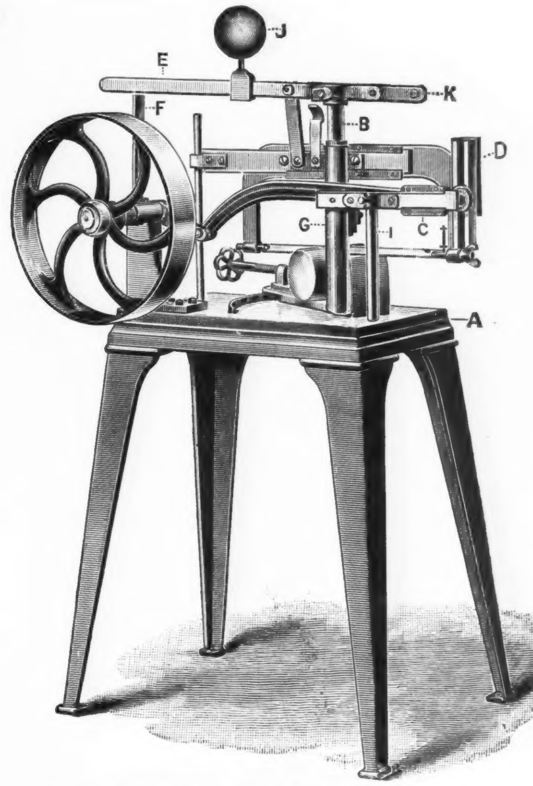
Fig. 6. Multiple Finishing Tool.

The steady rests are identical with those on the single tools except that the slotted stud is lengthened to accommodate two or more jaws. Each of the cutters is entirely independent and adjustable while the distance between the shoulders may be almost anything within the total range of the tool. The shank of all of these tools is hollow, in order that work may pass directly through the turret.

IMPROVED POWER HACK SAW MACHINE.

Although it is only a few years ago since the first power hack saw machine was brought out, it is now considered a necessity in every machine shop, and is a tool often found in other shops and in stores where bar iron and steel must be cut into lengths. The first power saws were crude tools that cut off stock, it is true, but in a haphazard and irregular way. No one would trust one of the earlier machines to saw off disks requiring to be finished to exact thickness without allowing a liberal margin for the "run of the saw."

In the power hack saw machine illustrated in the cut, we have a tool that is carefully designed and constructed. It produces quite remarkable work, it being possible to cut off very thin disks from a steel bar, showing little if any deviation from parallelism between the two sides. This result is obtained by certain features of design which constrain the saw blade to feed vertically downward in a perfectly straight line, there being no tendency for the connecting-rod to twist the saw out of true. By referring to the cut it will be seen that the connecting-rod is attached to the slide *C*, which moves on a guide entirely independent of the saw frame. The saw frame is not rigidly attached to the guide but is connected to it by a pin working in a verti-



Power Hack Saw, Cutting Steel Disks.

cal slot shown at *D*. This permits the saw to be moved up and down without changing the angularity of the connecting-rod, or in any way interfering with the regularity of the reciprocating motion. The saw frame is supported by a slide at the top moving on a horizontal guide attached to a sleeve. This sleeve encircles the vertical post *B*, the post acting as one of the vertical guides. A saw guide, adjustable in all directions, is attached to the sleeve so as to straddle the saw blade close to the work. Gages are provided for setting the saw blades truly vertical, but after a blade has once been set it may be quickly replaced by another without any adjustment whatever. This is considered to be an important feature in producing a true vertical cut, and preventing saw blades breaking. The saw frame is lifted and lowered by the lever *E*, and a weight *J* is mounted on the lever to regulate the cut. As the saw becomes dull the weight is moved outward on *E* to increase the leverage. The vise is swiveled so that it may be set for angular cuts. It is shown in the extreme angular position, or 45 degrees. No countershaft is required, there being a clutch with handle *F* attached to the machine for starting and stopping. When the work is sawed through, a bell rings continuously until the machine is stopped.

This power hack saw machine is made in three sizes, 2x2, 3x3, and 4½x4½ inches, by L. H. Olmsted, Hasbrouck Heights, N. J.

AUTOMATIC THREE-WAY BORING AND TAPPING MACHINES.

The machine shown in Fig. 1, p. 228, is used for tapping tees, crosses, elbows, globe, angle and cross valves, or in fact, any kind of work that requires tapping and is within the limits

of the capacity of the machine. It is capable of cutting simultaneously, three ½-inch pipe threads in brass.

The machine is spiral geared throughout and is absolutely noiseless. It is driven with a pair of wood and iron friction clutch pulleys with open and crossed belts. The countershaft has cones for three different speeds. The different feeds of the spindle are positive and are accomplished by change gears in a manner similar to that employed on a lathe. The feed gears are arranged with a clutch to which the spindles can be adjusted, independently of each other, for different depths of taps.

The chuck, shown in the photograph, is of the ordinary, two-jaw type with right and left hand screws, so adjusted as to receive special jaws for different kinds of work. In the place of this may be substituted a double chuck that is pivoted in the center and holds two pieces of work, back to back. The instant the taps have returned far enough out to clear the work, this chuck is revolved half way round and the new fitting is presented in front of the taps, and while the machine operates on this piece, the one previously finished is removed from the chuck and a new piece put in; in this way the delay due to taking out the finished piece and putting in a new piece, as is necessary on the single chuck, is avoided.

The regulator or governor is that part which is prominent on the housing of the center spindle. It has two small pulleys which are driven from the countershaft by independent

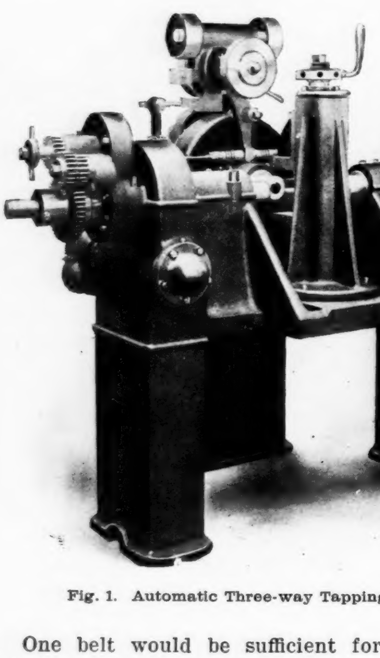


Fig. 1. Automatic Three-way Tapping Machine.

belts. One belt would be sufficient for the work required but if this should break there would be no means of reversing or stopping the machine except by stopping the countershaft, so the second belt is added for safety. The regulator is of the most positive action without any storage of power in springs. When the taps have cut deep enough into the work the regulator reverses the large friction clutch pulleys, unscrews the taps out of the work and stops the machine. The operator then revolves the chuck half way around, thereby bringing a new casting into position for machining, starts the machine and the operation is repeated. The operator can at any and all times control the machine by the crank handle on front of regulator, that is, he can stop it or reverse it or run the spindles all the way back, without interfering with the automatic adjustment of the tap. When the taps are going into the work the machine will reverse automatically at the proper distance in, and on coming the proper distance out it will stop.

The machine is provided with an arrangement whereby the taps, when they unscrew from the work, will start one after the other, the benefit of this being that they will not injure the thread in the work when coming back, and will start reversing very much easier than if the three spindles should all start backwards at the same time.

For tapping iron or steel the machine is furnished with an oil pump, and a wrought iron pan for catching the chips and oil.

A companion to this is the three-way boring machine shown in Fig. 2, which is similar in construction and operation to the tapping machine but bores and faces only. It is used on valves and fittings which require boring and facing previous to being tapped.

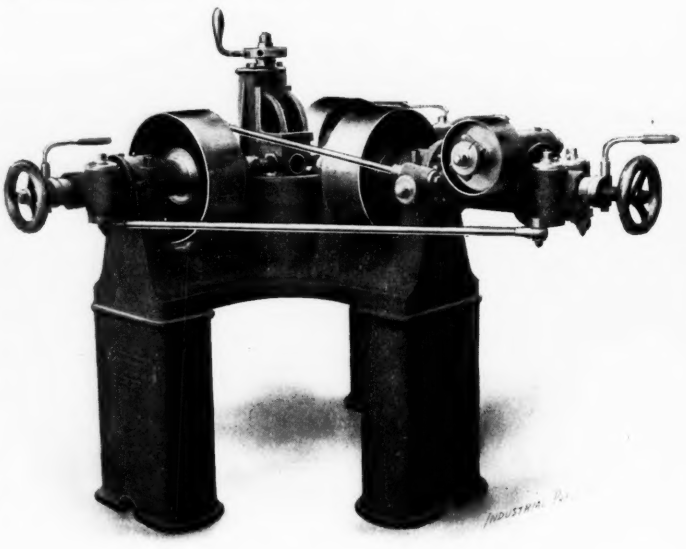


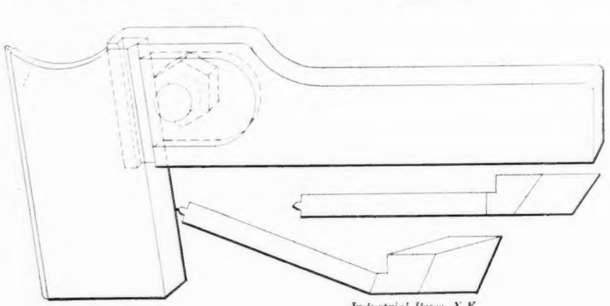
Fig. 2. Automatic Three-way Boring Machine.

The chuck, either single or double, is identical with that used on the tapping machine and the same special jaws will fit both machines. The cutting tool is a multiple combination of counterbore and facing tool and the feeding mechanism is so arranged that when the tool first enters the work the feed is quite coarse. As the tool goes deeper into the work the feed decreases until, when the flanges or ends of the work are being faced, one or two revolutions are made without any feed at all. This produces a smooth hole and a nicely finished surface. The tools have a quick return movement and three different feeds which may be instantly changed from one to the other. As soon as the tool has been withdrawn from the work the feed comes to a standstill while the spindle continues running, but the feed will not start until the operator is ready, when it is started by lifting a small handle on the front of the machine. Each spindle is provided with independent adjustments for depths.

Both of these machines are manufactured by Edward P. Walter, Bridgeport, Conn.

THE O. K. CUTTING-OFF TOOL.

A new and convenient cutting-off tool that has recently been patented and placed on the market by the O. K. Tool Holder Co., Shelton, Conn., is illustrated in the accompanying cut. The peculiarity of this tool, as will be seen, is the formation of a point in the center of the cutting edge. This breaks

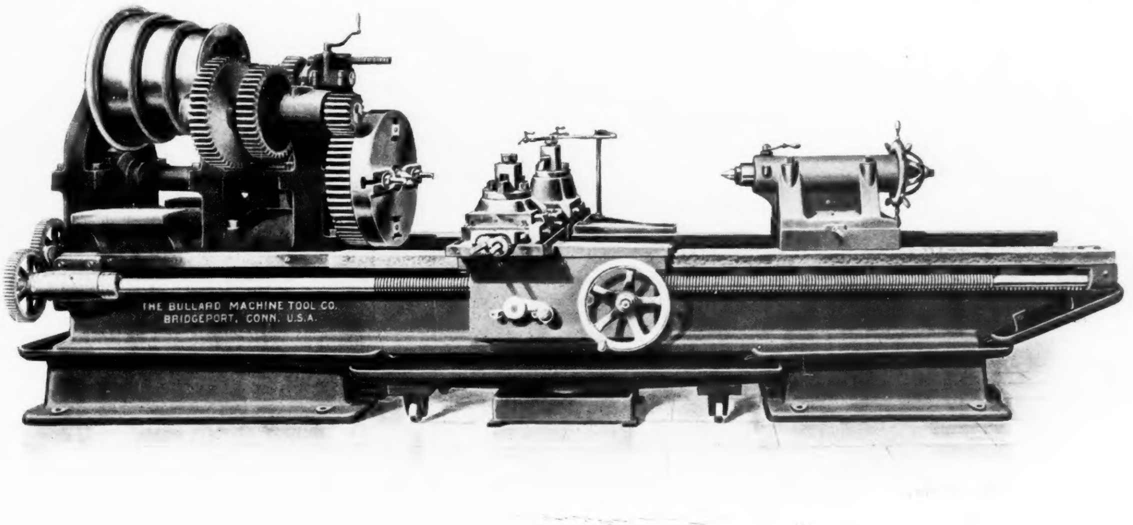


O. K. Cutting-off Tool.

up the chip and causes the tool to make a clean cut. In order to grind the blades they may be removed from the holder without changing its position, while the shape of the blades is such that grinding does not disturb the accuracy of the cutting edge. The tool can be adjusted to take a chip of any thickness and will not dig in, break or spoil the work. Straight or off-set blades may be used in the holder as is desired.

TWENTY-SIX INCH RAPID REDUCTION LATHE.

With the advent of the present high grades of tool steel, allowing cutting speeds of 100 to 200 feet per minute, a demand has arisen for tools that are qualified to withstand the increased service which the use of such speeds involves. It is to meet this demand that the Bullard Machine Tool Co., Bridgeport, Conn., have produced the "rapid reduction lathe" which is here illustrated. The simultaneous demand for great power and high speed makes the use of large gear reductions out of the question so that efficient driving power must be depended upon for accomplishing the work. Realizing the importance of this, the builders have designed this tool to be driven by a six-inch double belt, or, when electrically operated, by a 20 horse power variable speed motor. The lathe throughout possesses weight and solidity far in excess of that usually met with in machine tool construction. It swings 26 inches over the ways and 15 inches over the carriage. The bed, which is exceptionally heavy, weighs about 375 pounds per running foot and is regularly made in 14- and 16-foot lengths, taking 6 and 8 feet between the centers, but special beds can be furnished of any length desired.



Twenty-six Inch Rapid Reduction Lathe.

The tops of the column legs are completely surrounded by drip pans while between the legs are large pans that are mounted on rollers to facilitate their use. This arrangement of pans permits the copious use of water, which is supplied by a rotary pump capable of delivering five gallons per minute. The ways are flat and thus give an ample bearing surface for the carriage, while wipers on the ends of the carriage prevent chips from lodging and cutting the ways.

The headstock has a three step cone, the steps of which are respectively 18, 21 and 24 inches in diameter, and is faceplate geared in the ratio of 8 to 1 and 16 to 1. These gears are all completely inclosed by casings which are not shown in the photograph, having been removed in order to show clearly the details of the headstock. An equalizing driver is incorporated into the faceplate, thus permitting the use of double tailed dogs. All of the headstock journals have chain oiling bearings and liberal reservoirs are provided for the oil supply.

The carriage is gibbed, both front and back, and has a full length bearing of 38 inches on the ways. The cross slides, of which there are two, are square locked throughout, adjustment for wear being obtained through taper gibs. The front slide has a compound movement for dividing the cut between the front and rear tools. These tools are made from 1½ x 2½-inch stock. The slides are independent in their movements and have no power cross feed. The feed is driven by gearing and a powerful leadscrew which is located close to the bed and well under the forward way. This screw is engaged by a long lock nut operated from the apron, the Acme standard thread with which this screw is cut making engagement and disengagement very easy. Feed reverse is obtained by use of an intermediate gear on the headstock. On the long beds the leadscrew is carried in supports that are automatically placed, at given intervals, by the carriage as it travels along the bed. A quick-acting power traverse is provided for moving the carriage rapidly, also a rack and gear for moving both carriage and tailstock by hand. The tailstock has a 5-inch steel spindle and set-over movement. Center and follower rests partake of the same rigid and substantial features that are characteristic of the other parts of the lathe.

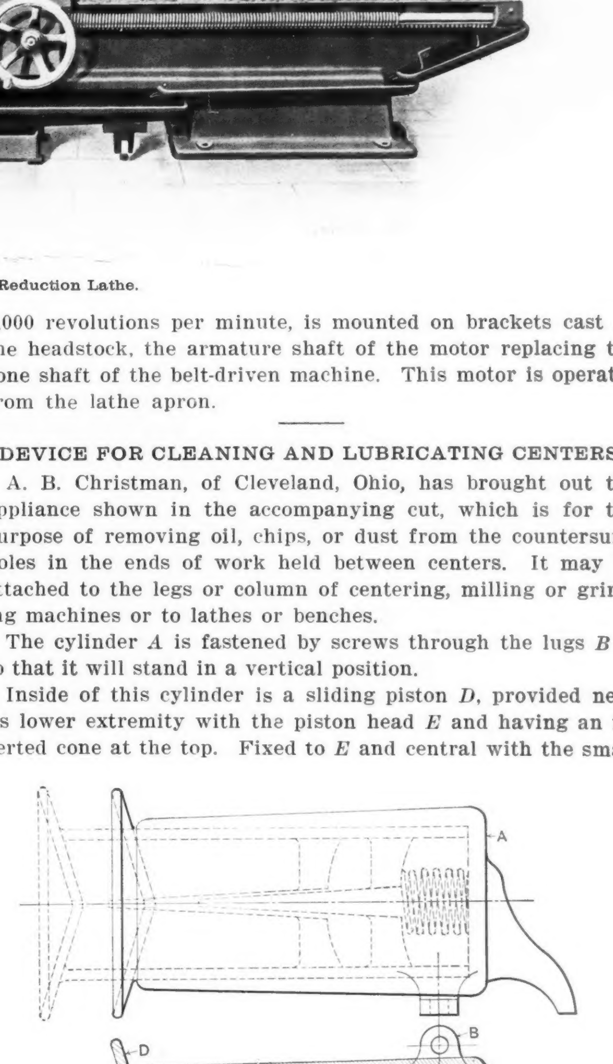
When it is desired to operate this tool electrically, a 20 horse power variable speed motor, capable of running 600 to 1,000 revolutions per minute, is mounted on brackets cast on the headstock, the armature shaft of the motor replacing the cone shaft of the belt-driven machine. This motor is operated from the lathe apron.

DEVICE FOR CLEANING AND LUBRICATING CENTERS.

A. B. Christman, of Cleveland, Ohio, has brought out the appliance shown in the accompanying cut, which is for the purpose of removing oil, chips, or dust from the countersunk holes in the ends of work held between centers. It may be attached to the legs or column of centering, milling or grinding machines or to lathes or benches.

The cylinder *A* is fastened by screws through the lugs *B B*, so that it will stand in a vertical position.

Inside of this cylinder is a sliding piston *D*, provided near its lower extremity with the piston head *E* and having an inverted cone at the top. Fixed to *E* and central with the small



Center Cleaning Device.

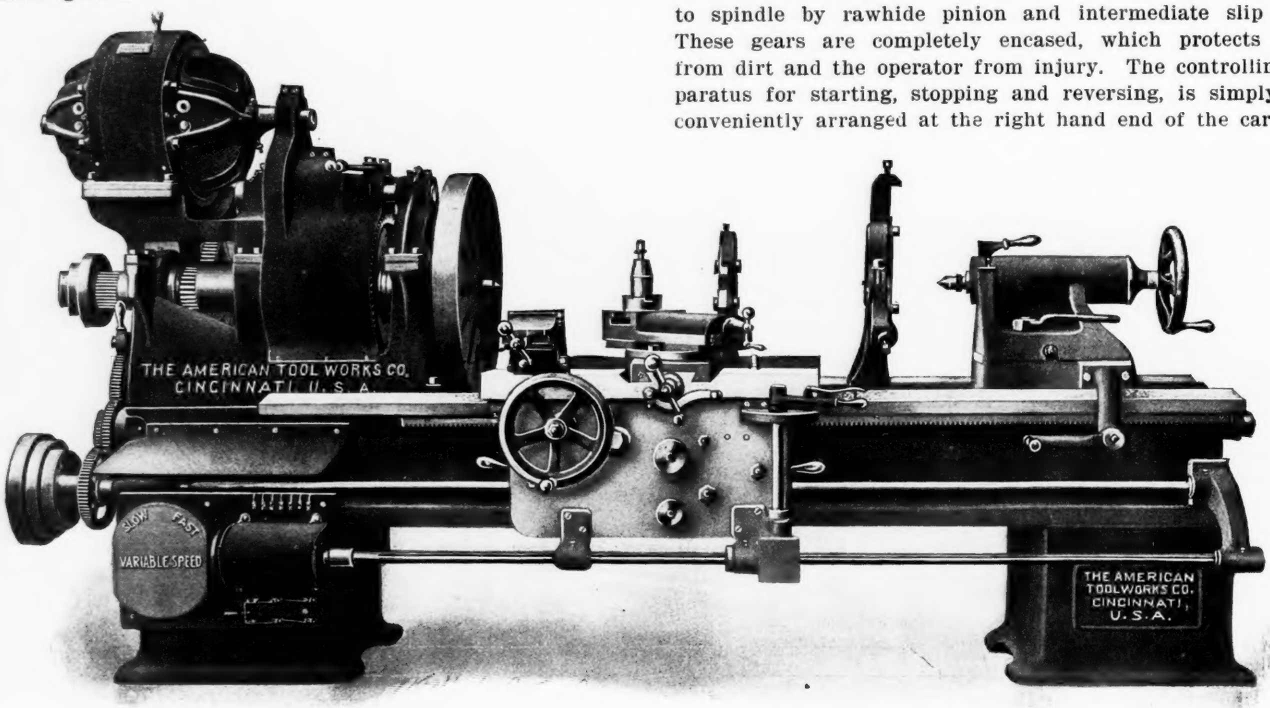
hole *H*, in the cone, is the nozzle *F*. A spring *G* keeps the piston well up in the cylinder, as shown by the dotted lines. The spaces *I I* and *J J* contain benzine, kerosene, or soda water. If it is desired to lubricate the center simultaneously with the cleaning, lard or machine oil is mixed with the cleaning fluid. The work is grasped in the hand and inserted in the cone as shown at *W*, with a slight downward pressure. This pushes the plunger *D* downward and a stream of the

liquid is forced upward into the center as shown at *K*. The liquid returns by gravity through the hole *H* into the chambers *I* and *J*, carrying with it all particles of dirt and chips, which are retained by the partition *E*. Cleaning of the device is necessary only at comparatively long intervals and is accomplished by lifting the piston *D* out of the cylinder and dumping. The capacity of the cleaner is about six ounces of cleaning fluid.

NEW "AMERICAN" MOTOR DRIVEN LATHE.

The application of electric drive has been adopted by the American Tool Works Co., Cincinnati, Ohio, for operating their 24-inch engine lathe, a photograph of which is here reproduced. This is their standard lathe having the leadscrew on the inside of the bed.

The motor is of the double commutator type, 3 H. P., and is mounted on a saddle on the head, with communication direct to spindle by rawhide pinion and intermediate slip gear. These gears are completely encased, which protects them from dirt and the operator from injury. The controlling apparatus for starting, stopping and reversing, is simply and conveniently arranged at the right hand end of the carriage.



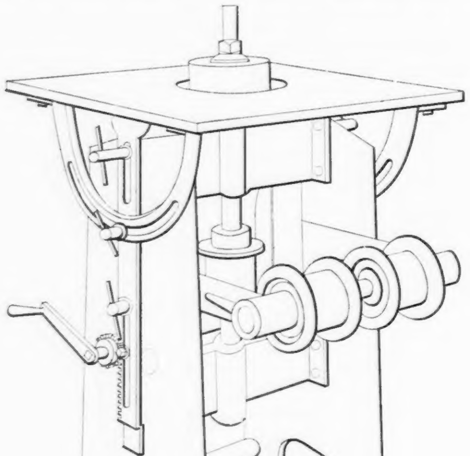
24-inch "American" Motor Driven Lathe.

There are four fundamental speeds obtainable from the motor itself through the speed controller directly under the head. This with the spindle gearing, gives a total of sixteen distinct and positive spindle speeds available. The efficiency of the motor is practically constant at all speeds. The motor, when reversed, runs at the same speed as when going forward.

* * *

VERTICAL EDGING AND INSIDE GRINDER.

The Tucker Machine Co., Cincinnati, Ohio, have recently brought out the vertical grinder shown in the engraving. This machine was originally built for use in stove foundries but has proved of value for grinding many kinds of castings such as plate castings, architectural iron work, etc. It is of the greatest convenience for grinding the inside of scrolls, circles or other parts that cannot be reached by the ordinary horizontal grinder. The work to be ground rests upon a horizontal table, two feet square, that can be tilted to any desired angle and may be raised and lowered, by means of a crank handle, through a space of four inches. The machine carries a wheel 2 inches to 8 inches in diameter by 4 inch face.



Vertical Edging and Inside Grinder.

LEAD VS. NICKEL (OR EDISON) BATTERIES FOR AUTOMOBILES.

Those interested in automobiles are waiting patiently for further information about the Edison storage battery, of which so much is expected. While, from the testimony of Mr. Edison, this battery has undoubted advantages, the most important of which are large capacity for a given weight and increased durability, it would appear from a paper read recently by Mr. Hugh Rodman before the Electro-chemical Society at Niagara Falls and reported in the *Electrical World and Engineer*, that the lead battery may still lay claims to favorable recognition. After discussing the numerous possible storage battery combinations and the corresponding reactions the conclusion is reached that the list of available anodes and electrolytes finally reduces to lead in sulphuric acid and nickel in an alkali hydroxide. Practically there are only two classes. First, lead peroxide and spongy lead upon lead plates in sulphuric acid—the battery in general use; and, second, mercuric or nickel peroxide upon nickel plates, together with cadmium, nickel or iron sponge upon iron or nickel plates in an alkali hydroxide—the battery proposed by Mr. Edison.

The alkali battery possesses a great advantage in making its support plates of a stiff, easily-worked metal. The stiffness insures absence of buckling (a trouble which must be considered and compensated for with lead plates), while the stiffness and ease of working together admit of a high mechanical perfection. It should be borne in mind, however, that the ordinary antimonial lead grid used with pasted lead plates is neither prohibitively heavy nor short-lived; it will probably last as long as the nickel grid when subjected to electrolytic action only; the inferiority lies in its mechanical weakness and in the difficulty of making fine castings.

In refilling the alkali cell pure or distilled water must be used, which is not necessary with the acid cell, and the alkali is also more troublesome in handling owing to its tendency to spread and its more destructive effect on clothes, hands and woodwork. The voltage of the alkali cell is only about one-half that of the lead cell, and for the same energy output we must double either the current or the number of cells. The alkali cell also has comparatively a small mass of electrolyte to draw upon.

Data are wanting upon the capacity of the alkali cell per unit of volume and weight, but it seems reasonably certain that neither will be far different from that of the pasted lead battery. As for reliability, which must not be mistaken for long life, data on the alkali cell are again wanting and must be wanting until the cells are put into ordinary service with ordinary care and attention.

For light service, such as for electric wagons, where watt efficiency and cost are to some extent subordinate to convenience, the choice between these two types will depend largely upon capacity and reliability.

The commercial life of lead plates in truck or cab service is about 15,000 to 20,000 miles for negatives, 12,000 miles for Plante positives and 6,000 miles for pasted positives. In other words, a four or five ton truck running 20 miles per day for 300 days in a year requires new positives once in a year or once in two years, according to the type of plate used, the choice of one or the other being determined by the character of service and length of run desired. Cabs and lighter wagons have about the same life, with a capacity of 40 to 100 miles on one charge.

* * *

In the June, 1902, issue of MACHINERY a description was given of the Keller pneumatic riveting hammer made by the Philadelphia Pneumatic Tool Co. Some readers who have studied the sectional cut, or who are familiar with the hammers themselves, may have wondered how the long 3-16-inch holes are drilled in the barrel parallel with the cylinder bore. In some of the long-stroke riveting hammers these holes are fully 13 inches long, so it would seem like a quite difficult job to drill them with ordinary appliances, but that is how they are done, except that the appliances are somewhat better than ordinary ones.

Seven Brown & Sharpe sensitive drilling machines built specially for this work are used in drilling the long holes in each barrel, the work being done progressively. The hammer barrels are mounted on jigs having a round, flat base, and each one remains in its jig until the holes are drilled clear through. The first operator starts the holes with a short 3-16-inch drill, and drills them to a depth of perhaps 2 inches. The next operator takes it on his machine and deepens the holes, say, 2 inches, and so on, the skill of the operators increasing with the depth of the holes and their ability to avoid breaking drills and spoiling work. The last operator in the line is a deaf mute and not likely to be distracted, which may partially account for his position in the line. The holes being drilled in this manner the long drills are always supported throughout most of their length by the walls of the hole, which insures the holes being straight, and because of the frequent changes there is not so much danger of their heating.

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FRESH FROM THE PRESS.

A GRAPHIC METHOD FOR SOLVING CERTAIN QUESTIONS IN ARITHMETIC AND ALGEBRA. By George L. Vose. No. 16 Van Nostrand Science Series bound in paper boards. Published by D. Van Nostrand Co., New York. Price 50 cents.

As the title indicates, this little book describes a graphic method that may be employed for solving certain problems in arithmetic and algebra. The graphic method is one that usually appeals to the practical man, and in this work he will find some quite knotty problems worked out with surprising ease by the use of simple diagrams.

PROBLEMS IN MECHANICS FOR ENGINEERING STUDENTS. By Frank B. Sanborn, Professor of Civil Engineering, Tufts College. Published by the Engineering News Pub. Co., 220 Broadway, New York. 155 pages illustrated. Price $1.50.

This little handbook should prove of great value to students. It is a collection of a large number of practical problems in mechanics, with their answers. It is thoroughly indexed, and as a class-room book and an aid to the instruction of students it will be found useful. The best way to learn mechanics is by working out problems, and one who has faithfully gone through this little volume cannot fail to gain a good knowledge of the subject.

MACHINE SHOP ARITHMETIC. By Fred H. Colvin and Walter L. Cheney. 131 pages and 8 diagrams, nicely bound in cloth. Published by the Derry-Collard Co., 256 Broadway, New York. Price 50 cents.

This is the third edition, eighth thousand, of a little book that has proven popular with machinists and others who have felt the need of a "pocket book containing some of the problems of everyday shop happenings, and affording their fast and accurate solution by easy methods." It is a book we have often recommended to young machinists who have not had the advantages of a good common school education, and who, realizing their deficiency in calculating simple shop problems, have been anxious to acquire a ready knowledge of machine shop arithmetic. The matter contained in the new edition has been revised and brought up to date. Larger type has been used and a larger page which materially improves its appearance and legibility. A chapter on the metric system and metric conversion tables has been added, also a page index.

WORM AND SPIRAL GEARING. By Frederick A. Halsey. No. 116 Van Nostrand Science Series. Published by D. Van Nostrand Co., New York. 85 16 mo. pages with numerous diagrams. Price, boards, 50 cents.

This book is a reprint of Mr. Halsey's articles on the above subjects that originally appeared in the columns of the *American Machinist*. The first part, dealing with the worm gear, considers the theory of worm efficiency, limiting speeds and pressures, and the various types of thrust bearings for use with the worm. The theoretical treatment is supplemented by a number of cases from actual experience showing the efficiency that can be obtained and the factors tending to produce this efficiency. The second part, after a few pages explaining the general principles of spiral gearing, illustrates the subject by the solution of a practical problem which is solved both by the analytic and the graphic methods. The concluding pages are devoted to a short treatise on the selection of spiral gear cutters by Mr. J. N. LeConte.

THE SLIDE VALVE. By Julius Begtrup, M. E. Published by D. Van Nostrand Co., New York. 143 8-vo. pages. Illustrated. Price, cloth, $2.00.

In this book Mr. Begtrup explains the principles of the various types of slide valves and also analyzes and describes a number of special valve constructions in order to exhibit in a comprehensive manner how the exacting conditions of high steam pressure and high speed have been met by modern engine builders. The information is presented in a more or less explanatory form supplemented by graphical demonstrations of the valve movements. The valve diagrams used in this book have been in use for the past ten years with, it is claimed, more general satisfaction than others that are better known. Beginning with a chapter on the common slide valve, the chapters successively deal with the improved forms of slide valve, including double-ported, balancing and piston valves; four valve systems, of which the Corliss is the most familiar type and independent cut-off valves. A chapter is also devoted to the slide valves of pumps, the valves of all the well-known makes of pumps being considered. The last chapter deals with the angularity of the connecting rod and eccentric rods and the effects which this produces on the steam distribution.

MATERIALS OF MACHINES. By Albert W. Smith, professor of Mechanical Engineering in Leland Stanford Junior University. Published by John Wiley & Sons, New York. 133 pages. Illustrated. Price, cloth, $1.00.

In the words of the author, this book is the result of an effort to bring together concisely the information necessary to him who has to select materials for machine parts. It is a systematic treatment of the materials with which the machine designer has to deal. It is therefore natural that a greater part of the work should be devoted to the subjects of iron and steel. The metallurgy of these materials is first taken up and this is followed by a description of the different steel processes and a few pages on foundry practice. A chapter is also devoted to the subject of testing, illustrated by stress-strain diagrams. The common alloys, principally the bronzes are considered and the final chapter takes up the different parts of the steam engine and machine tools and discusses the material best suited for the construction of each part.

A MANUAL OF DRAWING. By C. E. Coolidge, assistant professor of machine design, Sibley College, Cornell University. Published by John Wiley & Sons, New York. 92 8-vo. pages and 10 full-page plates. Price, paper, $1.00.

This manual was prepared for the use of the technical student with the object of presenting a standard drawing room system, the one embodied in this book being an average of the drawing room systems in use in the United States at the present day. It is the intention of the author that the system here outlined shall be supplemented by notes of the student's own acquirement, and for this purpose each page of reading is bound alternately with a blank page. The first part of the manual contains a treatment of the general subjects of drawing instruments, their care and use, drawing materials and blueprint reproduction. The second part is devoted to commercial mechanical drawings, closing with a few pages on the subject of Patent Office drawings. The text is quite thoroughly illustrated by 10 full-page plates of the various conventional forms, mechanical drawings and a Patent Office drawing.

MODERN ENGINEERING PRACTICE, published by the American School of Correspondence, Chicago, Ill. With an introduction by Frank W. Gunsaulus, President Armour Institute of Technology. 10 volumes, of about 350 pages each. Illustrated. Price for the set, $40.

The instruction pamphlets of the American School of Correspondence have been written by a selected list of writers, and these papers on mechanical engineering have been gathered together and published in this set of books. In reviewing the books it should be remembered that they are designed first of all, for home instruction and are intended for the man with limited education who wishes to advance in his chosen line of work. They are, therefore, elementary in their treatment and written as simply and clearly as possible. They are not to be considered as reference books for experienced draftsmen or engineers. Were a man, however, to make himself familiar with the contents of the volumes, he would have a good general knowledge of mechanical engineering and would have laid a substantial groundwork for future study. The mathematics of this course would carry him far enough so that after completing them, he should be able to read intelligently some of the more advanced text books by other publishers. The books are substantially bound, with leather backs, and the printing is clear. Part of the illustrations are from drawings made for this work and part are reproductions of cuts made for manufacturers' catalogues or for other purposes.

VOLS. I. AND II., MATHEMATICS, MECHANICS AND HEATING.—The first volume is taken up with a treatment of arithmetic, mensuration and elementary algebra. The second volume is a treatment of plane geometry, followed by chapters on elementary or applied mechanics and a brief treatment of the subject of heat. The chapters on mathematics cover about the same ground as the usual high-school text books except that the treatment is more condensed; and some subjects are omitted that are frequently taken up in high schools, especially in the treatise on arithmetic, which devotes more space to the fundamental rules and less to other branches of the subject, such as commercial arithmetic, etc. The algebra and trigonometry appear to be the most complete. The subjects of mechanics and heat are covered more fully than in the ordinary text book on physics, though not so completely as, for example, in Jamieson's, Dana's or Wood's elementary mechanics, with which some of our readers may be familiar.

VOLS. III. AND IV., FOUNDRY, FORGE AND MACHINE SHOP PRACTICE.—This volume contains about 300 pages in which space the three subjects mentioned above are treated and, as a matter of course, are not covered with anything like completeness since elaborate text books could be written on almost any one branch of shop work. The at-

tempt is made rather to present the general principles of common shop operations such as would be taught in a manual training school and which would help the apprentice in making a start.

Vol. IV., Machine Design and Boilers.—The chapters on machine design in this book follow very closely the lines laid down by such writers as Unwin, Low and other authors of standard works on this subject. Sketches are given of keys, cutters, bolts, bearings, clutches, flanges and other common machine parts and either formulas or tables are given for proportioning them. The author did not attempt to leave beaten paths or to collect material about recent advances in machine proportions. The sketches are for the most part similar to those in the older standard text books. By far the best part of the work is the treatment of boilers which contains rules or proportions for steam space, heating surface, tubes, grate area, etc., that apparently are well selected, together with a description of various types of boilers and boiler exhausters, including the steam calorimeter.

Vol. V., Chemistry, Metallurgy, Engines.—The chemical subjects are evidently calculated to give the mechanical man a general idea of the composition of ordinary materials that enter into machine construction. They are not intended to touch the subject of chemistry as a separate study. The treatise on the steam engine covers about the same ground as the usual handbooks on the steam engine for stationary engineers, but the subject is treated in a much better manner. There are first descriptions of different types of engines, including pumping engines and condensers and sketches with descriptions of the detailed parts of steam engines. This is followed by a description of governors and flywheels with simple calculations of pendulum and flywheel weights. Following this is a very good treatment of the steam engine indicator, much better than the usual treatise, largely because it is directly to the point and a lot of useless matter is omitted. After this is an explanation of the Zeuner valve diagram, with descriptions of several types of valve gear. The book closes with matter upon the action of steam, in which are calculations involving the use of steam tables, the capacities of condensers, the work done in an engine cylinder, etc.

Vol. VI., Marine Engine and Locomotive Work.—This is really a volume II. on the steam engine, taking up marine engines and locomotives. The subjects are treated in the same manner as the general principles of the steam engine are discussed in the last part of the previous volume. There is a chapter on marine boilers, one on railway cars and one on the air brake.

Vols. VII. and VIII. Electricity and Electrical Engineering. Vol. VII. forms a text book on elementary electricity and magnetism, following which generators, motors and electrical measurements are considered. Numerous calculations are introduced throughout this volume, none of them, however, of an advanced character, and they should be handled easily by one who has taken the earlier mathematics of the course. In volume VIII. are descriptions of various types of dynamo-electric machinery, an explanation of the alternating current transformers, with information upon electric railways and power transmission. These two volumes will be appreciated by men who are familiar with mechanics, and would like to have an advanced treatment of the elements of electricity, as practically applied in modern science.

Vol. IX., Heating, Ventilation and Plumbing.—Relatively speaking, these books seem to be more complete than the others mentioned, because the subjects themselves cover less ground and can be more fully treated within the scope of a single volume. This volume compares very favorably with other treatises upon the subjects, with which we are familiar. It will apparently meet the requirements of a mechanical man in a very satisfactory manner.

Vol. X., Mechanical Drawing.—This, it appears to us, is on the whole the most satisfactory volume of the series, and we believe it will prove as satisfactory to instructors and students as any text book on drawing we have seen. It takes up the usual geometrical work, projection, etc., and this is followed by a rarely good section on working drawings, quite original in its treatment and from which we publish an abstract in another part of the paper.

ADVERTISING LITERATURE.

The Billings & Spencer Co., Hartford, Conn. New circular and price list of drop-forged lathe dogs manufactured by this company.

E. G. Smith, Columbia, Pa. Pamphlet descriptive and illustrative of the "Columbia" calipers, spherometers, and screw micrometers. Also of the "Which Way" pocket level.

The Ransom Mfg. Co., Oshkosh, Wis. Catalogue "F" of grinding and polishing machinery. The various sizes and styles of these machines are described and illustrated.

The Frank Mossberg Co., Attleboro, Mass. Pocket catalogue of wrenches and of bicycle and automobile bells. The wrenches are made in several sizes and for various purposes, and the Mossberg bells are fully described and illustrated.

The Billings & Spencer Co., Hartford, Conn. Catalogue and price list of standard automobile forgings. These include forgings of every description in iron, steel, copper and bronze. A number of detail illustrations of various automobile parts are also given.

The Joseph Dixon Crucible Co., Jersey City, N. J. Leaflets giving information about the Dixon graphite pipe-joint compound for insuring a tight joint, but one that can be taken apart easily when necessary.

The Cleveland Wire Spring Co., Cleveland, O. Catalogue of agricultural implement springs and steel receptacles such as mortar and brick hods, hand barrows, nail boxes, various styles of shop boxes, etc.

The C. B. Manchester Gas Furnace Co., Providence, R. I. Circulars of gas furnaces. Twelve styles of furnaces are illustrated. These are for heating cutters, dies, reamers, etc.; for annealing work of steel, iron, brass and other metals; for wire annealing; for melting, plating, tempering, etc., and each is made in several sizes.

Hill, Clarke & Co., Boston, Chicago and New York. Circular descriptive of the Chicago speed lathe, built in 10-inch and 12-inch sizes by the Chicago Machine Tool Co. Also circular calling attention to the line of air compressors, pneumatic tools, pneumatic hoists and appliances manufactured by the Hill, Clarke Co.

The Diamond Machine Co., Providence, R. I. Proof sheets of the revised edition of their 1901 catalogue, indicating the changes in dimensions and measurements of a number of their machines and in several list prices. Descriptions of their "E" standard grinding machine and of their Nos. 1, 2 and 3 improved water tool grinders will also appear in the new edition.

The Buffalo Forge Co., Buffalo, N. Y. Folders treating of the company's new mechanically-induced draft fans and of Buffalo automatic engines. These engines include the center-crank horizontal, the side-crank horizontal, and the single upright types, simple and compound; also single upright marine engines and the double upright engines of the single and double-acting types.

The Derry-Collard Co, 256 Broadway, New York. Catalogue of books sold by the Derry-Collard method. This is one of the handsomest and most tastefully gotten up book catalogues we have seen. It lists 148 choice technical books, giving each a short and comprehensive description of the contents, number of pages, size of page, and character of binding. An index to the contents is given, which makes reference to any book description easy.

United States Gutta Percha Paint Co., Providence, R. I. Standard catalogue of Rice's 20th century finishes for machinery. These include adamant cement, machine paint, iron filler, enamels, shellac varnishes, etc. They also manufacture a paint thinner for thinning their steel-color paints which dries quickly and costs very little more than turpentine. Three pages in the back of the catalogue contain testimonials from a large number of firms using these products and showing the great variety of work for which they are fitted.

William Jessop & Sons, Ltd., Sheffield, England. Handsomely illustrated catalogue entitled "Jessop's Steel and How They Make It." The subjects of Sheffield steel, "blister steel," crucibles, melting furnaces, shear steel, Siemens steel, etc., are touched upon, and a large number of fine half-tones illustrate the various departments of the company's large works at Sheffield. The manufacture of a crankshaft from the ingot to the finished shaft is also illustrated. In the first pages appears an announcement of the establishment of an American works at Washington, Pa., where Sheffield steel is to be manufactured.

The Northern Electrical Mfg. Co., Madison, Wis. Catalogue No. 26 of the Northern electric motors. Illustrations are given showing these motors driving drill presses, radial drills, grinders, lathes planers, milling machines, etc., and many other varieties of machines such as sewing machines, paper cutters, ice machines, and air compressors. Vertical motors are shown, of the open and inclosed or dust-proof type for use in cases where other styles of electric motors are not practicable. Much interesting reading on the subject of electric driving is contained in this catalogue and it should prove valuable to those interested in this subject.

The Christensen Engineering Co., Milwaukee, Wis. Catalogues Nos. 53, 54 and 55, standard size, of the air brakes and electrical machinery manufactured by this company. Catalogue No. 53 describes the various parts that comprise the straight air brake equipment for electric cars or trains. No. 54 treats of Christensen air brakes and illustrates the company's new plant, with fine views of its various departments. No. 55 illustrates the direct-current motors and generators, alternating current generators and transformers they manufacture, and contains description of this electrical machinery and of its parts, together with other data and tables and detail drawings relative to the subject. All three catalogues are handsomely gotten up and will prove of value to those interested in the subjects there treated.

The Acme Machinery Co., Cleveland, O. 1902 catalogue of bolt and nut machinery. This catalogue is standard size, very complete and profusely illustrated. It calls attention to the many new features that have been added to their machines since the issue of their last catalogue. The new Acme die head is described and cuts are shown to illustrate its various parts. Then follow engravings and data of the regular Acme die head; Acme bolt cutters for work from 1/2 inch to 6 inches; 1 1/2-inch single staybolt cutters; a large variety of double and triple bolt cutters, of two, four, and six-spindle nut tappers, etc. A full description, with illustrations, is given of heading, upsetting and forging machines for work from 1/4 to 4 inches diameter, and a number of useful tables are reproduced together with much valuable information as to how to make, recut and grind dies, etc.

MANUFACTURERS' NOTES.

Mr. C. H. Schokmiller, for eight years master mechanic and foreman at the Inland Type Foundry Co., St. Louis, Mo., has resigned his position.

L. E. Rhodes has purchased the business of the Des Jardins Type Justifier Co., Hartford, Conn., and will begin the manufacture of high-grade special machinery and tools.

The C. W. Hunt Co., West New Brighton, N. Y., received the gold medal at the Dusseldorf exhibition for the "Hunt" conveyor manufactured by them.

The National-Acme Mfg. Co., Cleveland, O., announce the opening of a New England office at 45 Oliver St., Boston, Mass., in charge of Mr. M. M. Brunner.

The Cling-Surface Mfg. Co., Buffalo, N. Y., report a busy month, with increasing demands from abroad. Shipments of Cling-Surface have been made to England, the Bahamas, Russia, Australia, South Africa and Java.

Hardinge Brothers, Chicago, Ill., have purchased from Messrs. A. W. Gump & Co., Dayton, O., their entire Cataract precision lathe business and will hereafter manufacture this tool under the name of the Cataract precision lathe.

Pawling & Harnischfeger, Milwaukee, Wis., state that the demand for their cranes and hoists is excellent. They have recently booked orders for cranes and hoists from sixteen prominent firms in this country.

The W. P. Davis Machine Co., Rochester, N. Y., report that business has increased steadily. They have outgrown the building erected for them a few years ago. Two buildings in the rear were recently added, but these have proved insufficient, and the store next to them has just been leased.

The Burt Mfg. Co., Akron, O., have equipped a number of mills at the American Sheet Steel Co. with their Cross oil filters and Burt exhaust heads. The large new plant of the Allis-Chalmers Co., West Allis, Wis., has also recently been equipped with Cross oil filters.

The Marshall & Huschart Machinery Co., Cleveland, O., are now occupying their new warerooms, Nos. 24-26 Lake St. Their ground floor is 60x150 feet, and they have installed there a number of electrically-driven machines, manufactured by sixteen firms which they represent, which are in operation.

The Cushman Chuck Co., Hartford, Conn., advise us that to make additional room at their factory they have leased a large store and basement at 189 Allyn Street, near Union Station, to which their general office, with stock of finished chucks, has been removed. This makes available a considerable space in their factory which, together with contemplated additions, will be utilized for new machinery.

The E. Horton & Son Co., Windsor Locks, Conn., manufacturers of the well-known Horton chuck, are adding to their works another large building which, when completed and equipped with machinery, will enable them to more than double their present output. They are among the oldest chuck manufacturers in existence, having been in the business about fifty years.

Charles H. Besly & Co., 10-12 N. Canal St., Chicago, Ill., desire to call attention to their large and varied assortment of seamless brass and copper tubing. Brass rod, sheet, wire and brazed tubing; braziers' sheet copper, soft and cold-rolled copper anodes, brush copper for electrical purposes, German silver sheet, rod and wire are also carried. Their new store building on Clinton Street is progressing rapidly.

The Wilmarth & Morman Co. Grand Rapids, Mich., report that in the month of October their shipments were larger in amount than for any month for a full year past, and included New Yankee drill grinders only: A number of their dry grinders, 11 of their wet grinders, and in addition, 12 drill grinders to foreign countries. Also two of their large Style "G" or "Whale" grinders, the only drill grinder made for grinding drills as large as five inches.

The Philadelphia Pneumatic Tool Co., Philadelphia, Pa., state that their anticipated volume of business for September was fully realized, the sales for that month having been 20 per cent. more than any previous month. Large orders have recently been received from Great Britain, France, Italy and Denmark. Their German representative, Mr. Chas. G. Eckstein, is now in this country and will probably remain for some weeks.